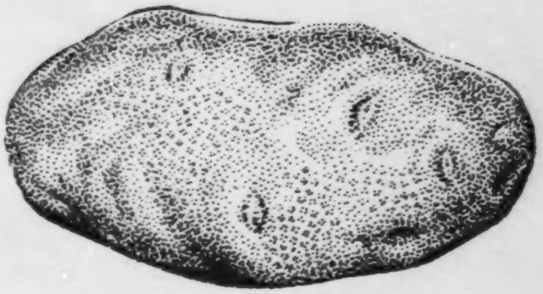
VOL. 3

New
Nouveau Brunswick



1990

TECHNICAL REPORTS ON POTATOES
RAPPORTS TECHNIQUES
SUR LES POMMES DE TERRE

POTATO CENTRE
CENTRE DE LA POMME DE TERRE
NEW BRUNSWICK DEPARTMENT OF AGRICULTURE
MINISTÈRE DE L'AGRICULTURE DU
NOUVEAU-BRUNSWICK

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NOUVEAU-BRUNSWICK

Robert W. Saintonge
Deputy Minister
Sous-Ministre

Alan R. Graham
Minister of Agriculture
Ministre de l'Agriculture

92-07535/

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FOREWORD

This is the third annual publication of the Technical Reports on Potatoes.

The purpose of the Reports is to provide farmers and agricultural specialists a summary of the major applied research and demonstration projects on potato production in New Brunswick.

My sincere gratitude to the specialists who conducted these projects and submitted reports and to the potato growers who provided farm land, machinery and other assistance.

The financial contributions of the Canada-New Brunswick Cooperation Agreement on Agri-Food Development are acknowledged in supporting many of the projects.

My thanks also to Guy Bernard, editor of this publication.

Clair Gartley, Director
Western Region/Potato Centre

PRÉFACE

Voici la troisième publication annuelle des rapports techniques sur les pommes de terre.

Le but de ces rapports est de fournir aux agriculteurs, agricultrices et aux spécialistes en agriculture, un sommaire des projets majeurs de recherche et de démonstration sur la production des pommes de terre au Nouveau-Brunswick.

Mes sincères remerciements aux spécialistes en charge des projets qui ont soumis ces rapports et aux producteurs qui ont fourni leur aide et qui ont mis leur terre et leur machinerie à notre disposition.

Je veux également souligner la contribution financière accordée pour un grand nombre de ces projets en vertu du l'Entente auxiliaire Canada/Nouveau-Brunswick sur le développement du secteur agro-alimentaire.

Mes remerciements également à Guy Bernard, éditeur de cette publication.

Clair Gartley, directeur
Région de l'Ouest/Centre de la pomme de terre

THE 1990 GROWING SEASON

George Read

ABSTRACT: The 1990 Growing season was generally very wet in the spring, late summer and fall, with an extended dry period from June to mid-July. Heat units were slightly above normal with normal spring frosts and late fall frosts.

SAISON DE CULTURE DE 1990

Résumé: La saison de culture de 1990 a été généralement très humide au printemps, à la fin de l'été et à l'automne, mais elle a été entrecoupée par une période prolongée de temps sec entre juin à la mi-juillet. Le nombre de degrés-jours était un peu supérieur à la normale, et les gelées du printemps et de la fin d'automne ne s'écartaient pas de la normale.

INTRODUCTION: Generalizing the weather conditions for and entire province for an entire season does not explain crop performance on individual farms or even separate regions for the most part. The climate of farms varies significantly from one location to another with such things as frost occurrence, crop development, planting, insect and disease development or harvesting operations. It is therefore necessary to evaluate specific varieties, recommendations and production practices with the most localized or representative information as possible.

Despite these farm scale influences, the overall performance of crops on a provincial scale can often be correlated with major deviations from normal growing season conditions, such as droughts, wet periods, extensive frosts or unusually warm or cold seasons. With these factors recognized, a general summary of the 1988 cropping season weather is presented.

SUMMARY: With the exception of the extreme Northwestern part of the province, which was near normal, the month of May was very wet. Some locations received almost 300 % of normal with most ranging from 150 to 225 % above normal. After a warm period in late April-early May, heat units accumulations for the month were slighly above normal.

June was slightly above normal in temperature and well below normal in rainfall throughout most of the province, except for the upper Saint John river valley. The period from June 1st to June 20th was very dry.

Although total rainfall for the month was generally well above normal this is a bit misleading, as many locations continued very dry for the first three weeks of July. This situation combined with a dry June resulted in low moisture status of many soils. Heat units continued to increase and accumulated values from May 1st were generally 5 to 10 % above seasonal values, slightly higher in the North.

Rainfall was highly variable in August, indicating several thunderstorm type of events. Woodstock had over 300 mm of rainfall compared to a normal of 82.9 mm. St. Stephen, Sussex, and Saint John were all well below normal for the month. The rest of the province was slightly to well above normal. Heat units were above normal (approx 10%) for this time of year.

September rainfall and temperatures were near normal.
Accumulated Growing Degree-days and Corn Heat Units were generally 5 - 15 % above normal for the May 1st - September 30th period.

Slight frosts were recorded in early September, however a heavy frost was not recorded until mid-October.

The month of October was very poor for harvesting operations. The first 23 days of October recorded rainfall on 22 days, not permitting any significant drying out of wet soils.

INSPECTION OF GREENHOUSES FOR THE PRESENCE OF POTATO INFESTING APHIDS IN 1990

INSPECTION DES SERRES EN 1990 POUR LA PRÉSENCE DE PUCERONS INFESTANT LES POMMES DE TERRE

GUY BERNARD

ABSTRACT:

Green peach aphids were frequently found in greenhouses inspected during the spring of 1990. Greenhouses thus continue to provide local sources of aphids which can contribute to the spread of viral diseases in seed potato crops.

RÉSUMÉ:

Des pucerons verts du pêcher furent fréquemment détectés dans les serres au printemps de 1990. Les serres continuent donc à être un réservoir local de pucerons pouvant contribuer à la dissémination de maladies virales dans les récoltes de pommes de terre de semence.

Many species of aphids can play a role as vectors of virus diseases. The green peach aphid, in particular, is the principal vector of PLRV (Leafroll) and an efficient vector of PVY (Mosaic) to potatoes. Both diseases can cause yield reductions if seed tubers are affected. In addition, plants of susceptible varieties infected with PLRV will often develop a tuber disorder, known as net necrosis, which greatly affects the quality of table and processing potatoes.

These two diseases, leafroll and mosaic, account for a substantial proportion of seed field rejections each year in New Brunswick. Since the tolerance for virus diseases in seed crops is low, seed growers are acutely aware of the potential for disease transmission from aphids alighting in their fields.

The green peach aphid overwinters on peach trees in southern locations. Closer to us, in the State of Maine, it often overwinters on the Canada plum in the form of eggs. In New Brunswick however, the green peach aphid does not ordinarily overwinter on the Canada plum but it can survive the winter in greenhouses. It can also be brought in on transplants imported from other regions.

In a survey of 25 greenhouses, conducted in the potato belt of New Brunswick on May 23rd and May 24th, 1990, 36% of the greenhouses were found to be infested with green peach aphids. Winged forms were present in 3 of these greenhouses. Since plants from these greenhouses were to be sold and distributed widely throughout potato growing areas, there was a possibility that the aphids they harboured could become an early source of infestation in seed fields.

Early infestations of seed fields by aphids can substantially increase in-field virus transmission if inoculum levels are high in the crop.

In an attempt to reduce these local sources of green peach aphids, all greenhouse operators in the province were contacted on June 1, 1990, and asked to co-operate by making sure that all the plants they sold were free of aphids. In a follow-up survey of 22 greenhouses which was conducted June 5th and 6th, 1990, 14 greenhouses were found to be infested with green peach aphids. Winged forms were present in 6 of these greenhouses. Common potato aphids were also detected in 10 greenhouses, and aphids belonging to the aphis spp. and which may have included some buckthorn aphids were found in 12 greenhouses. Only 8 greenhouses were completely free of aphids at the time of inspection.

It thus appears that local greenhouses continue to be a source of green peach aphids which may initiate populations in potato fields later on in the season and contribute to the spread of viral diseases in the seed crop.

AERIAL MONITORING OF POTATO INFESTING APHIDS IN NEW BRUNSWICK IN 1990

ENQUETE SUR LES VOLS DE PUCERONS INFESTANT LES POMMES DE TERRE AU NOUVEAU BRUNSWICK EN 1990

GUY BERNARD

ABSTRACT:

Green peach aphid catches in yellow pan traps were moderate during the 1990 season. The greatest numbers were caught during the last three weeks of August. Common potato aphid catches were higher than average while buckthorn aphid catches remained relatively high for the second consecutive season.

RÉSUME:

Les captures de pucerons verts du pêcher dans les pièges jaunes furent modérées durant la saison 1990. Les captures les plus importantes furent effectuées durant les trois dernières semaines du mois d'août. Les captures de pucerons communs de la pomme de terre furent élevées tandis que celles de pucerons du nerprun atteignirent un niveau relativement élevé pour la seconde année consécutive.

Aphids, mainly because of their ability to transmit virus diseases, are an important pest of potatoes. The Green Peach Aphid (Mp), in particular, is the major vector of PLRV (leafroll) and an efficient vector of PVY (mosaic). Both of these diseases account for a substantial proportion of the seed field rejections each year in New Brunswick. Aphid populations have been monitored extensively in the Province since 1974 and a warning service based on aphid catches in yellow pan traps has been available to potato producers ever since.

In 1990, 100 yellow pan traps were operated in the province mostly in the counties of Carleton, Victoria and Madawaska. Contents of yellow pan traps are collected by growers in seed fields and by scouts in table and processing potato fields. Samples are brought to the Agricultural Resource Centre in Wicklow for identification. As part of the aphid advisory service, weekly reports on aphid flights, based on these trappings, are sent to cooperating farmers, inspectors and others during the growing season. Information is also made available to all growers through the use of a toll-free telephone answering service, and personal letters to producers.

The practice of setting mandatory topkill dates for seed potato crops, which was established in New Brunswick in 1981, was discontinued during the 1990 season. Potato growers were simply advised to apply a topkiller to seed crops as soon as possible after the occurrence of significant green peach aphid catches in their region.

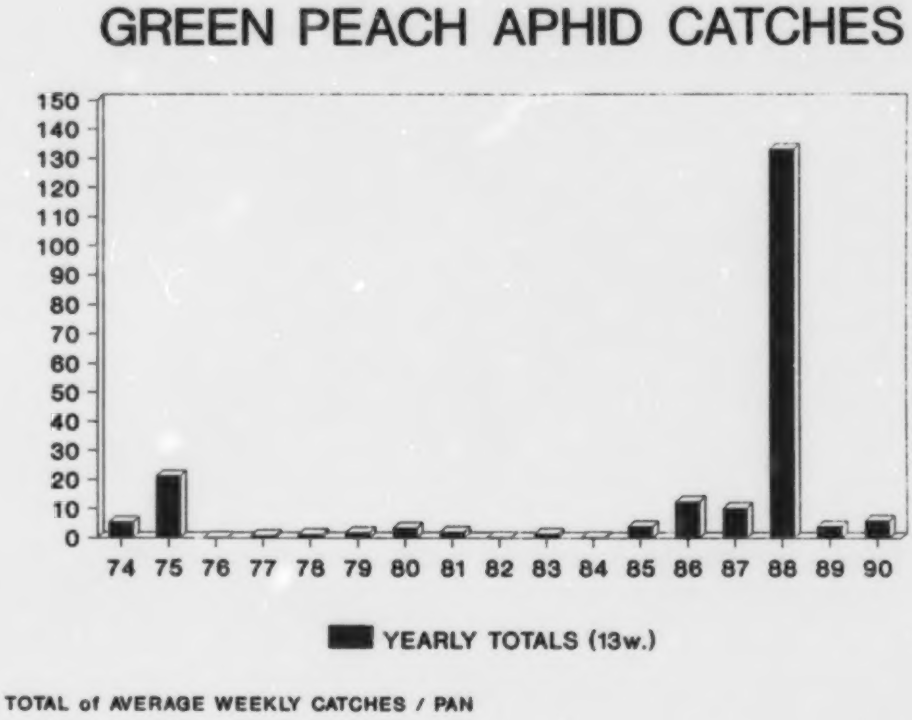
The first catches of green peach aphids for the 1990 season occurred on July 9th near Woodstock and on July 25th near Bath. On August 2nd, there were two more catches; the first one at Bon Accord and the next in the northern part of the province, near Clair.

Flight activity in the potato belt started in earnest on August 6th and during the following days and weeks, green peach aphids were caught regularly in small numbers and in most localities.

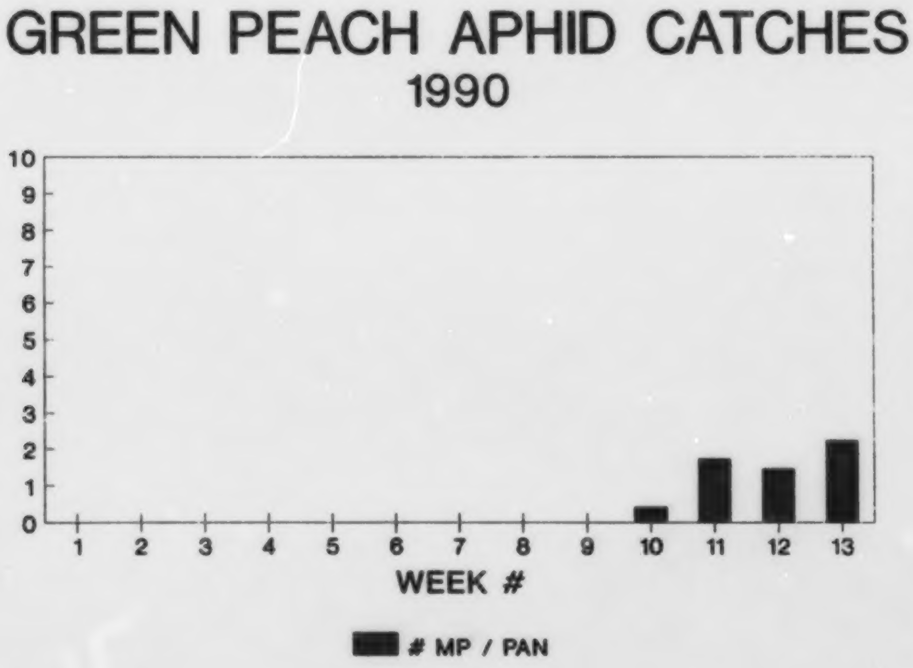
Overall catches of Green peach aphids (Mp) in yellow pan traps were only moderate during the 1990 season (Graph #1). The greatest numbers were caught during the last three weeks of August (Graph #2).

Catches of the buckthorn aphid (An) remained relatively high for the second consecutive season (Graph #3) and occurred throughout the summer, but were highest in August (Graph #4). Common potato aphid catches were also high this season (Graph #5). They also culminated in August (Graph #6). Of the latter two aphid species, only the buckthorn aphid is thought to be able to play a significant role in PVY transmission. Catches of other aphid species were lower than average in 1990 (Graph #7) and also peaked around mid August (Graph #8).

GRAPH #1

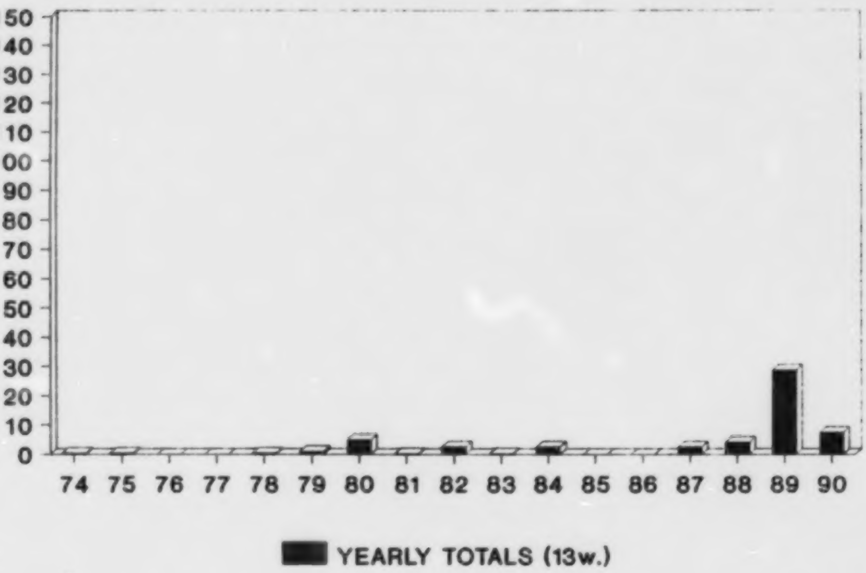


GRAPH #2



GRAPH #3

BUCKTHORN APHID CATCHES

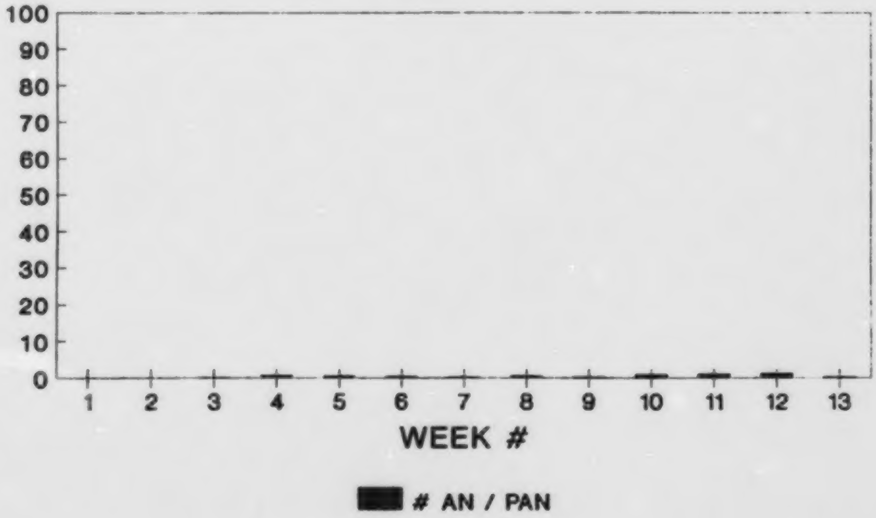


TOTAL of AVERAGE WEEKLY CATCHES / PAN

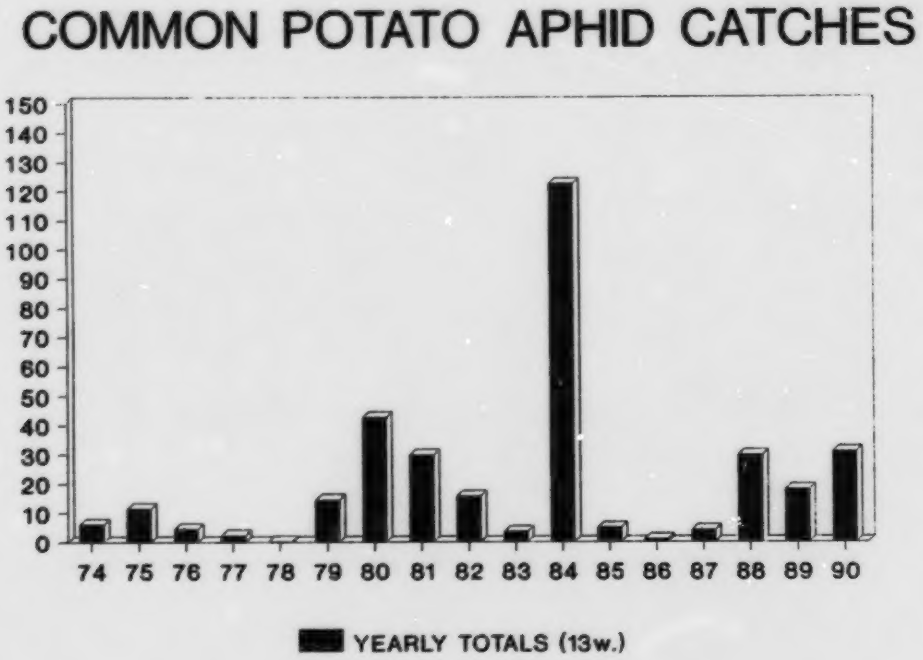
GRAPH #4

BUCKTHORN APHID CATCHES

1990

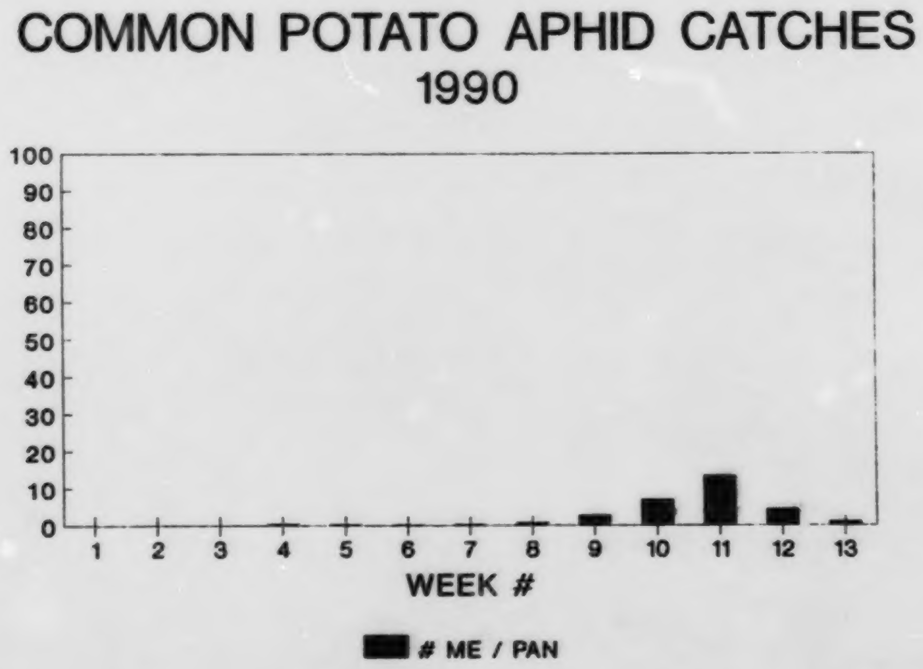


GRAPH #5

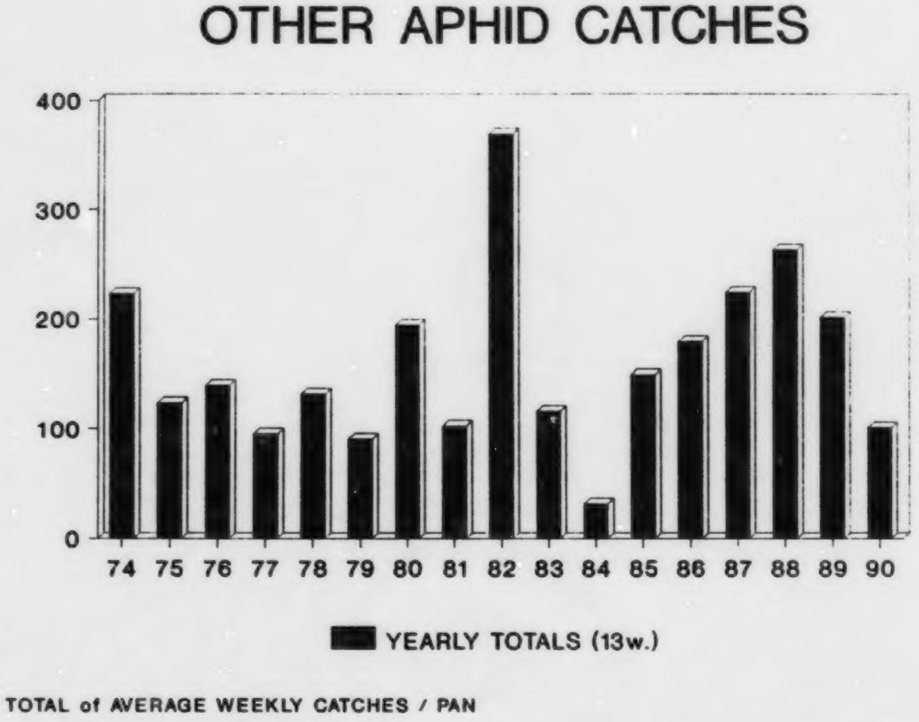


TOTAL of AVERAGE WEEKLY CATCHES / PAN

GRAPH #6



GRAPH #7



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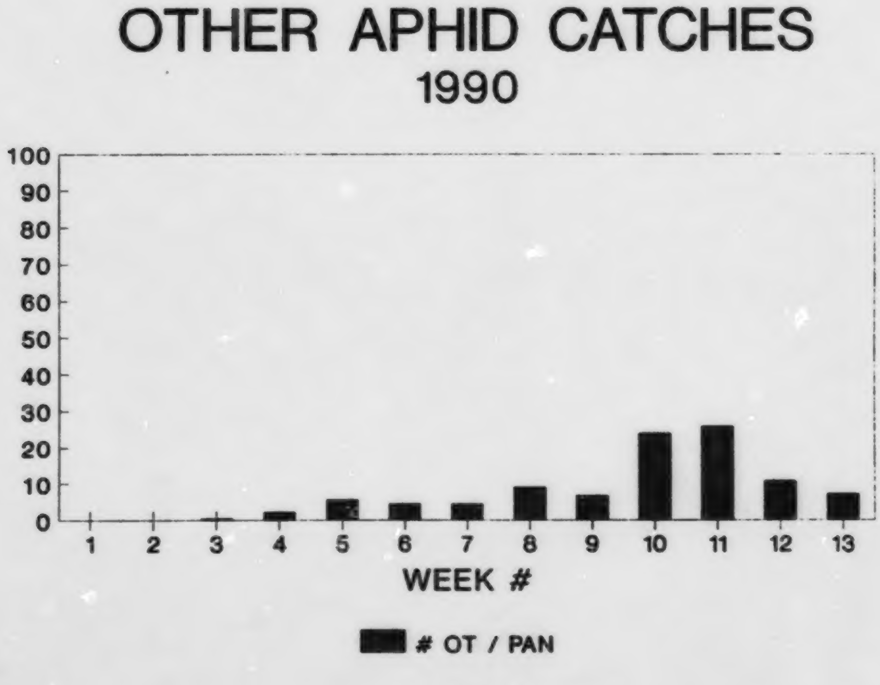


MONITORING OF INSECT POPULATIONS IN POTATO FIELDS IN 1990

ENQUÊTE SUR LES INFESTATIONS D'INSECTES DANS LES CHAMPS DE POMMES DE TERRE EN 1990

GUY BERNARD

ABSTRACT:

Aphid populations were moderate during the 1990 season. Colorado Potato Beetle populations were high and unusually large numbers of adults appeared in potato fields in the spring and during the month of August. Infestation levels were higher than those observed in previous years. Flea Beetle populations were similar to those of 1989 and damage levels were generally low.

RÉSUMÉ:

Les populations de pucerons furent modérées durant la saison 1990. Les infestations cependant, débutèrent tôt dans les champs de pommes de terre. Les populations de doryphores furent élevées et un grand nombre d'adultes apparurent dans les champs de pommes de terre au printemps et durant le mois d'août. Le niveau des infestations cette année dépassa celui des années précédentes. Les populations d'altises furent similaires à celles de 1989 et le niveau des dommages demeura généralement bas.

The most common insects in potato fields in New Brunswick are the Colorado Potato Beetle, several species of colonizing aphids and the Potato Flea Beetle. Colorado Potato Beetles are chewing insects. They can cause substantial reductions in yield if defoliation is extensive and occurs during a sensitive growth period.

Aphids are sucking insects. Many are vectors of virus diseases and as such, they are of particular concern to seed growers since tolerances for viruses are low in seed crops. Aphids can also reduce yields if infestations are severe.

Potato Flea Beetles are small insects which chew holes in potato leaves. Yield reductions are most likely to occur only if populations are very high late in the season.

In 1990, insect populations were monitored weekly in 35 fields in the potato belt. A sample area was established in each field early in the spring and data were collected from within the plot for a period of 13 weeks.

Aphid populations were estimated by counting the number of winged and wingless aphids of each species on the whole surface of one bottom, one middle and one top leaf per plant on a total of 30 plants per plot.

Colorado Potato Beetle infestations were evaluated by counting the number of larvae as well as adults in each plot on a total of 30 whole plants. Defoliation data were also collected again in 1990.

Flea beetle damage was evaluated by counting the number of feeding holes on the terminal leaflet of the fourth leaf from the top of the plant on 14 plants per plot.

The main purpose of this data collection in potato fields has always been to provide growers with timely and easy to understand information that would help them better schedule insecticide applications and avoid unnecessary treatments.

In 1990, as in previous years, an HP85 microcomputer was used to produce reports in the field immediately after monitoring. The reports clearly show the trends in aphid populations and provide growers with a visual evaluation of the success or failure of insecticidal treatments (Graph 1).

Data collected from the 35 fields sample is also used to provide information to all growers on field populations of insects. This information is available through the use of a toll-free telephone answering service and personal letters to producers.

To summarize the 1990 insect monitoring season: The percentage of fields infested with Potato Flea Beetles was high in the spring. This percentage decreased gradually as the summer progressed only to augment again during the latter part of August. Damage levels however remained low throughout the summer.

Aphid populations were generally moderate during the 1990 growing season. Buckthorn aphids appeared early in potato fields and winged forms were detected on potato plants throughout the season. The common potato aphid was the dominant species this year. It's numbers increased substantially during the month of August. Green peach aphid populations were again relatively low. The highest numbers were recorded on potato plants during the latter part of August.

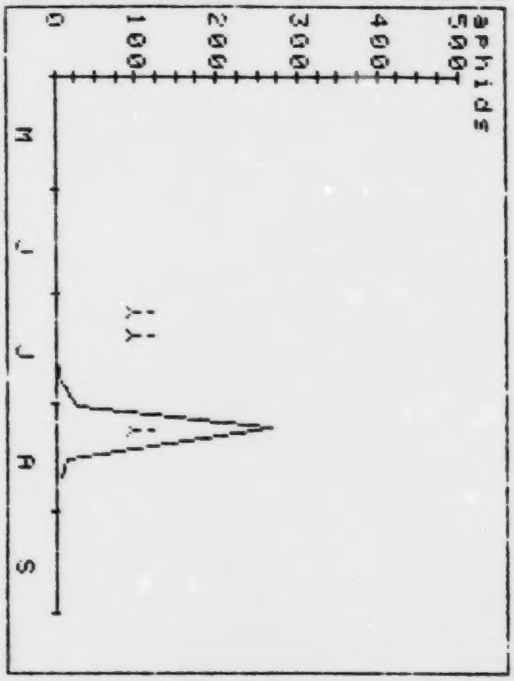
Colorado Potato Beetle populations were high again this year. Unusually high numbers of overwintering adults appeared in the spring and in some instances caused damages to portions of fields soon after emergence. The percentage of fields infested with both adults and larvae remained high throughout the season and numbers exceeded the levels recorded in previous years. At the close of the 1990 season, 87% of the fields were still infested with adults and 81% were still infested with larvae. Unusually large numbers of adults were detected in fields throughout the month of August but defoliation levels were not severe enough, in most cases, to justify treatment with an insecticide. Colorado Potato Beetles were hard to control, this year again, with chemical insecticides.

In order to assess the level of resistance to insecticides in local Colorado Potato Beetle populations, samples of adults were collected from 27 farms during the 1990 season. The results of this assessment are summarized on page 21 of this report.

The following graphs (Graph 2 to 12) depict the weekly status of insect populations in 35 potato fields during the summer of 1990. Although strongly biased by insecticide applications, they have nevertheless been included for the record and to provide a continuing basis for comparisons.

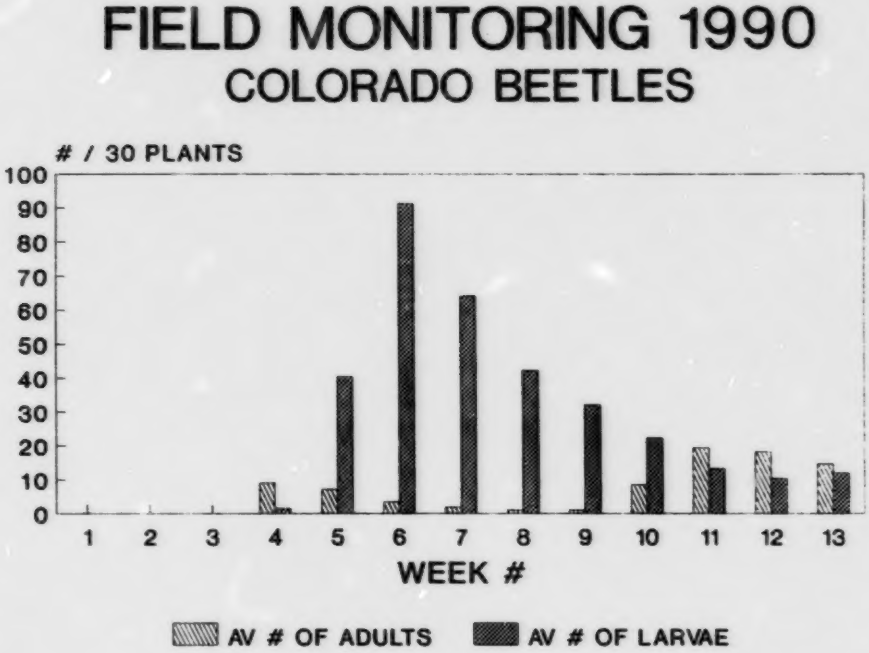
GRAPH #1

```
----------------------------------------
GROWER# 5
DATE AUGUST 22
INSECTICIDE APPLICATIONS
 7 / 6  SUPRAC A 1L/A
 7 / 13  THIODAN  5L/A
 8 / 9  PIRIMOR 2 5KG/A
----------------------------------------
APHID POPULATION CURVE
total # of aphids on 90 leaves
```



```
----------------------------------------
OF THE  9  APHIDS COUNTED
IN YOUR FIELD TODAY
 1  WERE GREEN PEACH WINGED
 3  WERE   GREEN PEACH
 0  WERE POTATO WINGED
 5  WERE   POTATO
 0  WERE BUCKTHORN WINGED
 0  WERE   BUCKTHORN
----------------------------------------
 19.8 % OF THE PLANTS
 WERE INFESTED
AVERAGE FLEA BEETLE DAMAGE = 0
 HOLES/LEAF
COLORADO BEETLES WERE DETECTED
IN YOUR FIELD
FOR MORE INFORMATION CALL GUY
```

GRAPH #2



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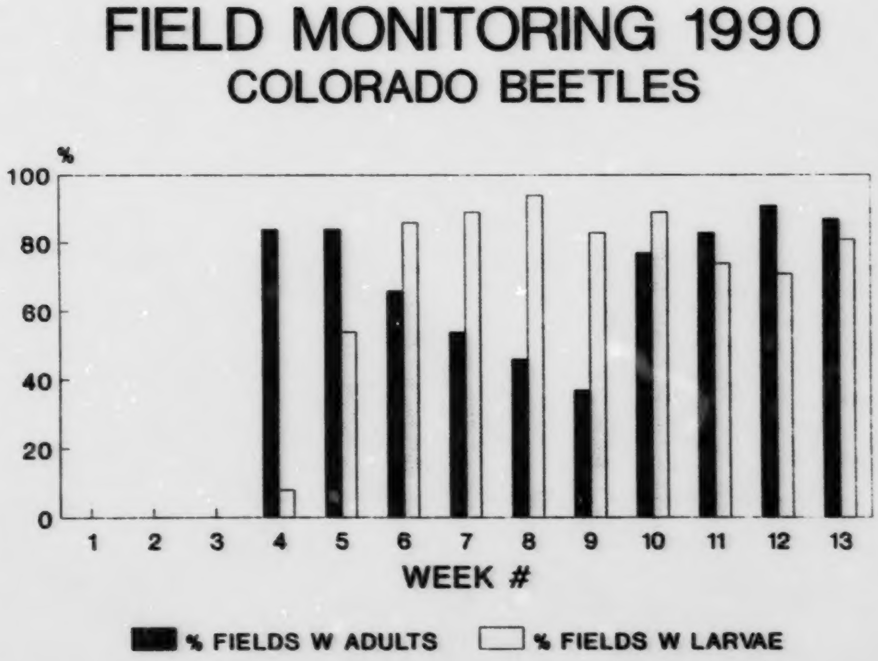

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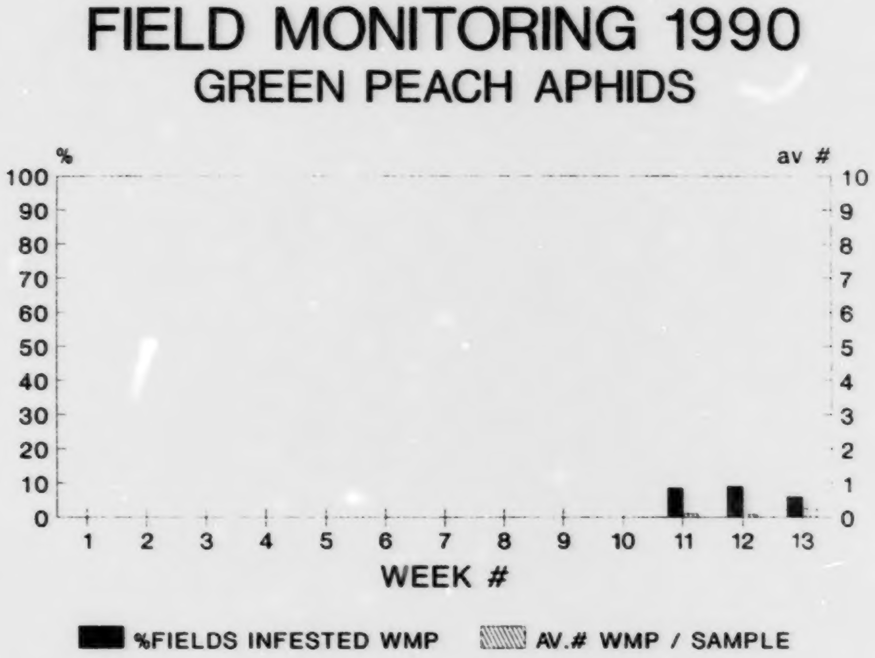

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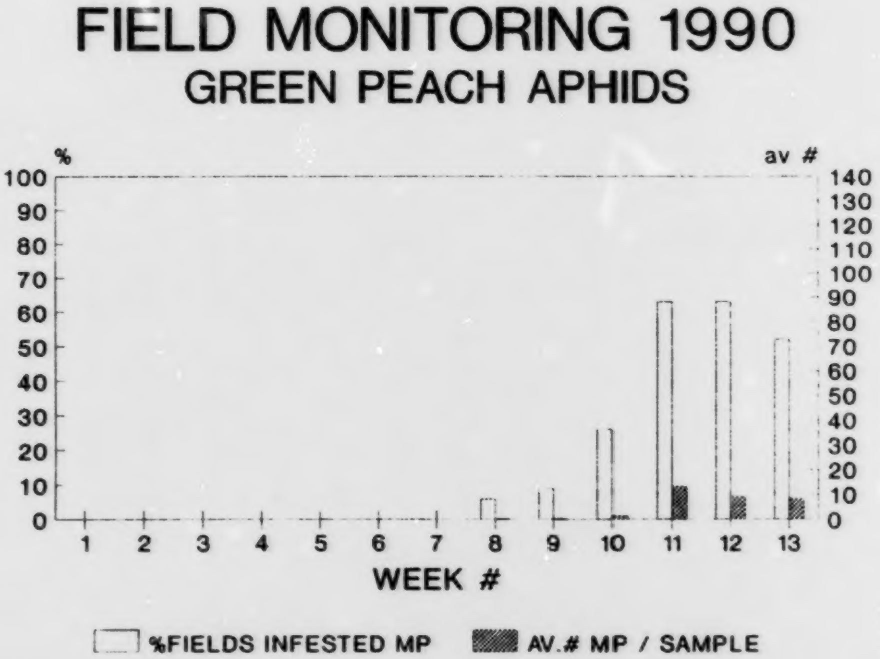

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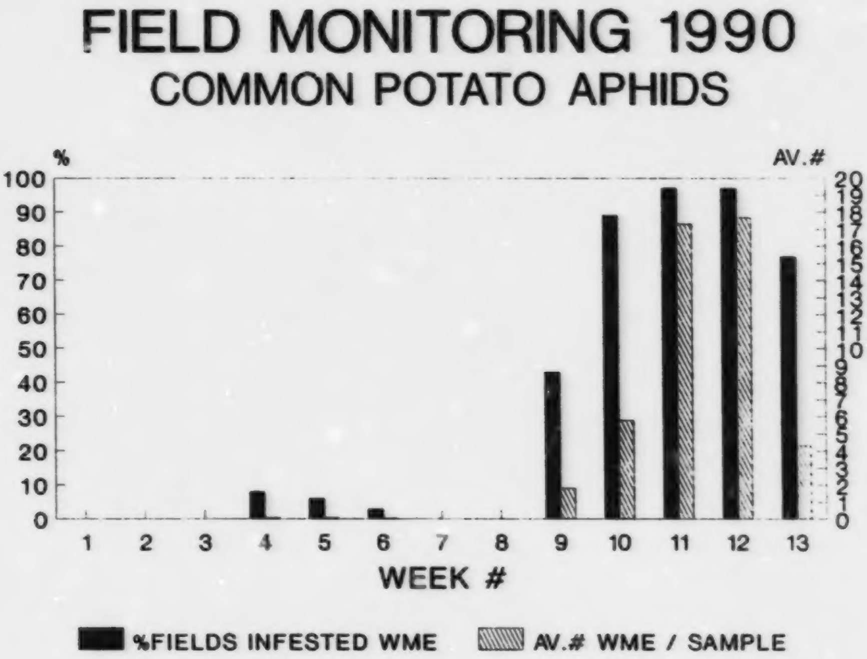

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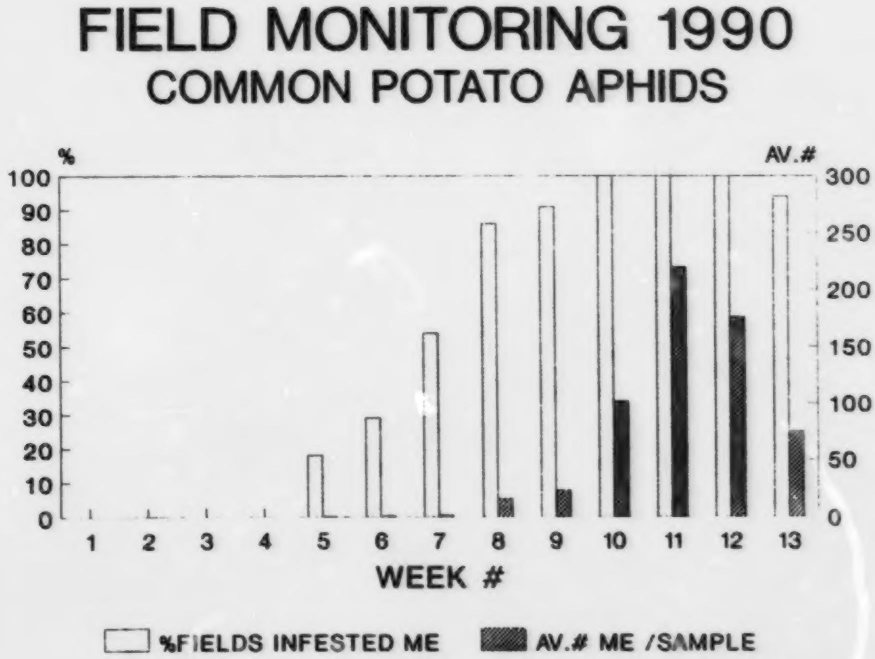
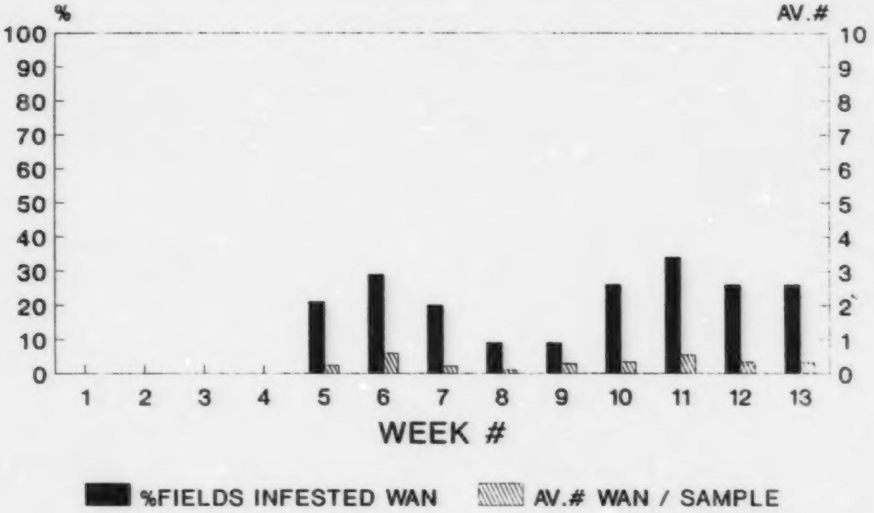


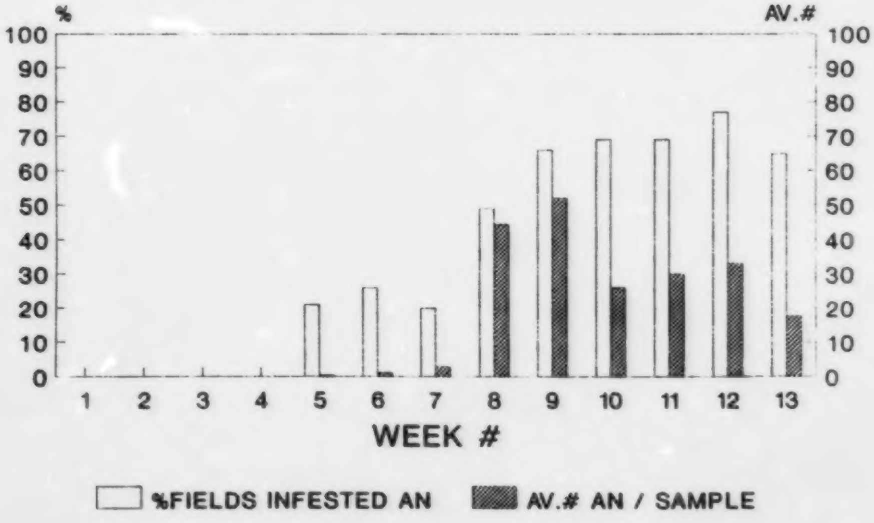
GRAPH #8

FIELD MONITORING 1990
BUCKTHORN APHIDS



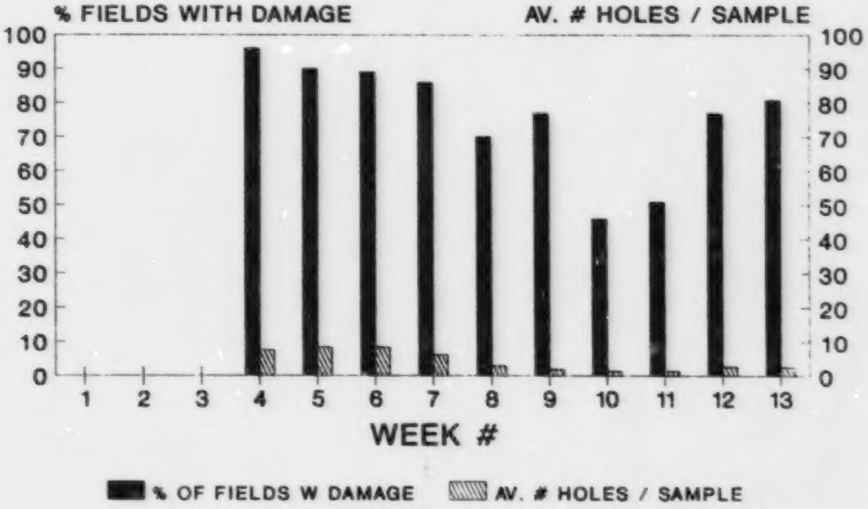
GRAPH #9

FIELD MONITORING 1990
BUCKTHORN APHIDS



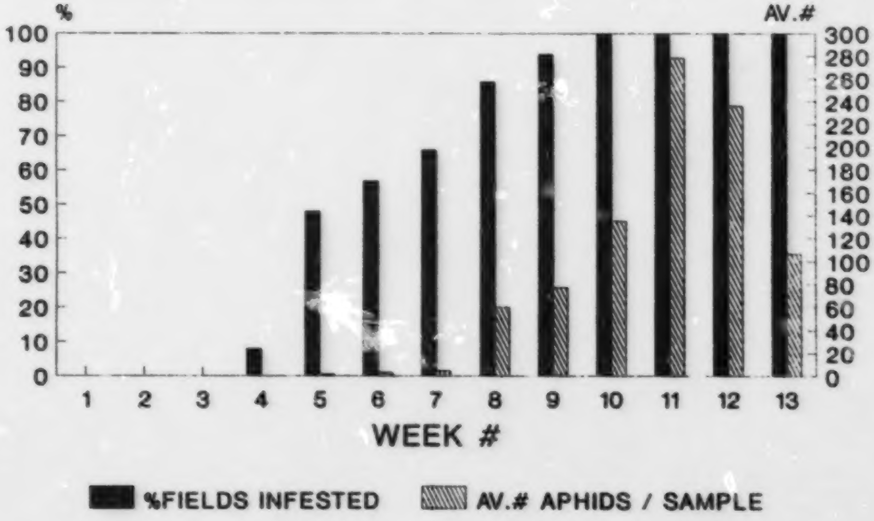
GRAPH #10

FIELD MONITORING 1990
FLEA BEETLE DAMAGE

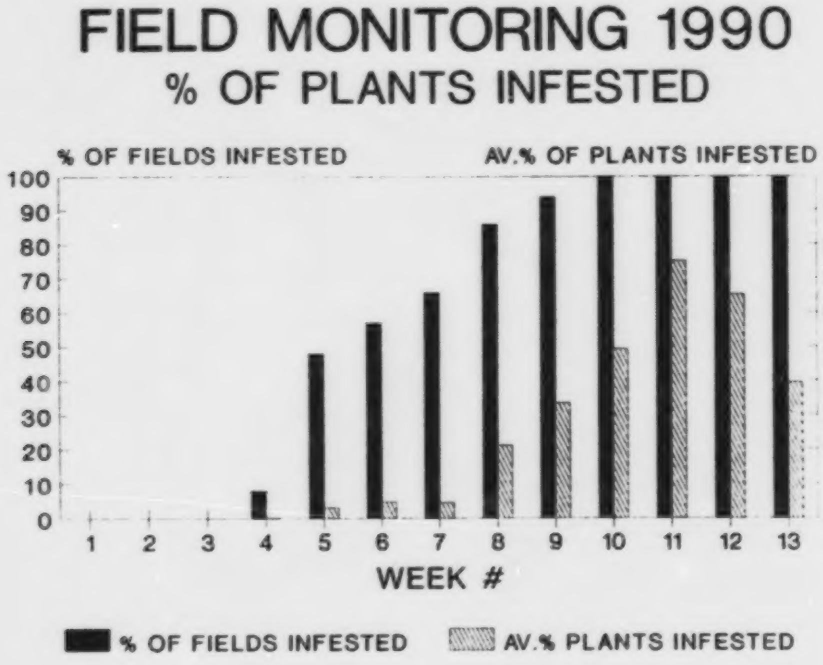


GRAPH #11

FIELD MONITORING 1990
TOTAL APHID INFESTATIONS



GRAPH #12


FIELD MONITORING 1990
% OF PLANTS INFESTED
% OF FIELDS INFESTED
AV.% OF PLANTS INFESTED
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
WEEK #
% OF FIELDS INFESTED
AV.% PLANTS INFESTED

EVALUATION OF RESISTANCE TO INSECTICIDES IN NEW BRUNSWICK POPULATIONS OF COLORADO POTATO BEETLES

ÉVALUATION DU NIVEAU DE RÉSISTANCE AUX INSECTICIDES PARMI LES POPULATIONS DE DORYPHORES DU NOUVEAU-BRUNSWICK

GUY BERNARD

ABSTRACT:

Twenty-seven samples of Colorado Potato Beetles were evaluated in 1990 to determine their level of resistance to several commonly used insecticides. Although the level of resistance to many insecticides has increased recently in New Brunswick, potato growers can still obtain good level of control with some products.

RÉSUMÉ:

Vingt-sept échantillons de doryphores furent évalués en 1990 afin de déterminer leur niveau de résistance à plusieurs insecticides d'usage commun. Bien que le niveau de résistance à plusieurs insecticides ait augmenté récemment au Nouveau-Brunswick, les producteurs de pommes de terre peuvent encore obtenir un bon niveau de contrôle avec certains produits.

During the spring and summer of 1990, 27 samples, consisting generally of 500 adult colorado potato beetles were collected in New Brunswick potato fields.

Through the collaboration of Dr. Gilles Boiteau, Entomologist with Agriculture Canada in Fredericton, these samples were shipped to the Agriculture Canada Research Centre in London, Ontario. Mrs. Stephanie A. Turnbull, Biologist at the Centre, conducted resistance studies on the samples using several commonly used insecticides.

As this will be the subject of a future paper, only the highlights and conclusion provided by Mrs. Turnbull are summarized below:

- Of 21 populations tested with Endosulfan (Thiodan), 18 had moderate to high resistance levels to the product.
- There was high resistance to Carbofuran (Furadan) in 12 of 19 populations tested.
- The majority of populations showed low levels of resistance to Synthetic Pyrethroids (Decis, Cymbush, Belmark).

- All the populations tested showed low resistance to Azinphosmethyl (Guthion)

- Phorate (Thimet) resistance occurred in 4 of 9 populations tested.

Mrs. Turnbull's conclusions were that New Brunswick potato growers can still obtain good control of Colorado potato beetles with currently registered compounds and that further development of resistances could be delayed if growers adopted good management strategies.

EVALUATION OF A NEEM TREE EXTRACT, A FATTY ACID AND FORMULATIONS OF BACILLUS THURINGIENSIS FOR THE CONTROL OF COLORADO POTATO BEETLES

ÉVALUATION D'EXTRAITS DE NEEM, D'ACIDES GRAS ET DE DIFFÉRENTES FORMULATIONS DE BACILLUS THURINGIENSIS POUR LE CONTRÔLE DU DORYPHORE DE LA POMME DE TERRE

GUY BERNARD

ABSTRACT: All the products and combination of products tried were generally effective at reducing larvae population of colorado potato beetles on potato plants. Of the biologicals, both Neem and Trounce showed a considerable degree of effectiveness in controlling adult stages of the beetle. They also reduced populations of the buckthorn and common potato aphids.

Trounce was phytotoxic at the dosage and frequency used. Ambush and Ambush combination treatments seemed to have had a positive effect on yields above and beyond those derived from insect control alone

RÉSUMÉ: Tous les produits et combinaisons de produits furent généralement efficaces à réduire le nombre de larves sur les plants de pommes de terre. Le Neem et le Trounce furent également efficaces pour le contrôle des adultes du doryphore et réduisirent le nombre de pucerons du nerprun et de pucerons communs de la pomme de terre.

Trounce démontra des effets phytotoxiques à la dose et fréquence d'utilisation indiquées. Ambush et les traitements d'Ambush combinés semblèrent avoir un effet positif sur les rendements en sus de ceux résultant du contrôle des insectes.

INTRODUCTION:

Colorado potato beetle populations have been on the increase in recent years in New Brunswick. Both the larvae and the adult of the beetle are capable of causing substantial damage to potato plants. While plants are normally able to compensate for some damage, yield reductions are likely to occur if defoliation is too severe or if it is inflicted during a sensitive growth period or a period of stress.

The most common methods of reducing colorado potato beetle damage to potato crops in New Brunswick are the use of crop rotations and the use of chemical insecticides either banded in the soil at planting or sprayed on the foliage during the growing season.

The purpose of this experiment was to evaluate the use of a Neem tree extract, a fatty acid and formulations of Bacillus thuringiensis (B.t.) as alternative control methods.

MATERIALS & METHODS:

A randomized complete block design was used for this experiment. Treatments were as follows:

M-ONE	A 12.5% water dispersable suspension of B.t. used at a rate of 6 L/ha.
M-ONE (followed by Ambush)	Early applications of M-one alone used at a rate of 6L/ha. followed later in the season by applications of Ambush alone at a rate of 0.2L/ha.
AMBUSH (followed by M-One)	Early applications of Ambush alone at a rate of 0.2L/ha. followed later during the season by applications of M-One alone at a rate of 6L/ha.
M-Cap [MYX 1806]	An aqueous solution containing 10% encapsulated endotoxin of B.t. used at a rate of 6L/ha.
CONTROL	Only water was used in this treatment
TROUNCE	An insecticidal soap containing 20% potassium salts of fatty acids and .2% pyrethins used at a concentration of 50 ml/L of water.
NEEM	An extract from the Neem tree used at a concentration of 11 g/L of water.
AMBUSH	A synthetic pyrethroid insecticide used at a rate of 0.2 L/ha.

The experiment was planted on May 15th, 1990 in the Grand Falls area on ground likely to be infested with colorado potato beetles. Each treatment was replicated four times and consisted of two 4.57m rows of E2 Red Pontiac potatoes spaced 0.91m apart. Seed spacing was 30.5 cm between sets. Each seed piece was cut in advance to a weight of 50 g ± 5 g. Sets were planted by hand to ensure uniformity and accuracy. Fertilizer was applied with a conventional planter at a rate of 1120 kg/ha of 15-15-15. A 0.91m wide strip of wheat, which later formed a dense barrier, was seeded around each treatment after potato emergence to impede the movement of larvae and adults between plots. Weeding and hilling operations were done by hand. A conventional backpack sprayer was used to apply the foliar treatments.

Dithane M-45 and Ridonil MZ were used to control foliar diseases.

Observations on flea beetle damage and on aphid infestations were collected on July 25th and 26th and on August 14th and 15th.

Flea beetle damage was evaluated by counting the number of feeding holes on the terminal leaflet of the fourth leaf from the top of the plant on a total of 10 plants per plot.

Aphid infestations were evaluated by counting the number of aphids of each species on one compound leaf per plant on a total of 10 plants per plot.

The first young larvae (1st instar) of the season were detected on a few plants on June 18th. A count was conducted immediately after on June 19th to determine if there were large differences in infestation levels for each treatment, which may later influence the outcome of the experiment.

The following schedule of foliar applications was adopted:

The M-One plots received applications of M-One on June 22, June 27, July 3, July 10 and July 17. Similarly, the M-Cap plots were sprayed on June 22, June 27, July 3, July 10 and July 17.

Foliar applications of Neem, water for the control, Ambush and Trounce were made on the appropriate plots on June 27, July 3, July 10 and July 17th.

The June 27th application was followed by rain in the afternoon.
The July 3rd application was followed by a heavy rain.
The July 10th application was followed by a light but steady rain.

Reglone, a topkiller, was applied to the experiment on August 23rd. The plots were harvested and yield data was collected on September 4th, 1990.

Observations on Colorado potato beetle abundance were collected on June 19, July 5 and 6, July 16, July 25 and 26th. In all instances, data were collected on all plants in each treatment.

RESULTS:

ADULTS & EGG MASSES

The results indicate (Graph 1, Table 1) that prior to the application of any spray, initial dispersion of adults within the experimental site and their subsequent egg depositions were relatively uneven. Average results of later counts, however, indicate that those did not materially affect the outcome of the experiment. Populations of adults varied from a low of .19 to a high of .63 beetles per plant. The average number of egg masses per plant varied from a low of .94 to a high of 1.31.

Subsequently, populations of adults were significantly diminished, when compared to the control in the Neem, Trounce, Ambush and Ambush combination treatment on which only Ambush had been used (Graph 2, Table 2).

Average number of adults per plant varied from a low of .07 for the Neem and Trounce treatments to a high of .29 for the Control. Egg laying was lowest for the Neem treatment with .39 egg masses per plant and highest for the control with .69 egg masses per plant but these differences were not significant.

Similarly, on July 16 (Graph 3, Table 3), populations of adults were significantly lower, when compared to all others, in treatments of Neem, Trounce, the Ambush and Ambush combination treatment which had just been treated with Ambush.

Average numbers of adults per plant varied from a low of .03 for the Neem treatment to a high of .48 for the M-One treatment.

Egg laying was again lowest for the Neem treatment as well as the Ambush and Ambush combination treatment on which Ambush had recently been applied. Some of these differences were significant.

The same pattern was apparent on July 25, 26 (Graph 4, Table 4). Treatments of Neem, Trounce and Ambush had the lowest populations of adults while the Ambush combination treatment which had most recently been sprayed with Ambush offered good control.

Egg laying was lowest in the Neem, Trounce, Ambush and Ambush combination treatment which had most recently been sprayed with Ambush. Some of the differences were also significant.

By August 14, 15, approximately one month after the application of the last spray, a new generation of adults had appeared in the plots. By this time, the population of beetles in the plots was significantly higher in the control when compared to all other treatments, a consequence of greater larvae survival (Graph 5, Table 5).

Surprisingly, the number of egg masses was highest on the Ambush and the Ambush combination treatment most recently sprayed with Ambush. Some of the differences were significant.

Larvae:

Results of the first count effectuated on July 5th and 6th (Graph 6, Table 6) show a lack of control of 1st instar larvae for the Neem treatment. This condition did not persist and larvae of the 2nd and 3rd instar were effectively controlled for all treatments when compared to the Control. The population of the 4th instar larvae was low and there were no significant differences between treatments.

Results of the July 16th count (Graph 7, Table 7) indicate that there were no significant differences in control level between the treatments for the 1st instar larvae. All products, however, effectively diminished the number of 2nd, 3rd and 4th instar larvae when compared with the control.

By July 25th and 26th (Graph 8, Table 8), there was a resurgence of larvae of all instars in the Trounce treatment. With later instars, all other products were effective in reducing the population of larvae when compared with the Control.

By August 14 and 15 (Graph 9, Table 9), one month after the last treatment, results, as expected, were quite variable. Populations of 3rd and 4th instar larvae, when compared with the Control, were still diminished in treatments of Trounce, Neem, Ambush and M-One combination treatment more recently sprayed with Ambush.

It appears from the previous analyses that all treatments were generally very effective at reducing the number of larvae of 2nd, 3rd and 4th instar on potato plants soon after they had been sprayed.

The Trounce treatment unfortunately showed signs of phytotoxicity. Plants were noticeably stunted and stressed during the season. The Ambush treatment and to a lesser extent, both combination treatments having included Ambush, were noticeably more vigourous than all other treatments. Plants of these treatments were taller, much greener with a bluish sheen, had larger stems and wider leaves, and flowered more profusely. Flowers in these treatments persisted long after other treatments had ceased flowering. This remarkable effect was also noticed in the previous year, but so far the reasons for this noticeable increase in vigour remain obscure.

APHIDS AND FLEA BEETLES:

To determine the effectiveness of some of the biologicals against other pests, data were also collected on the level of damage inflicted by flea beetles and on the populations of aphids on the plants.

The results of counts taken on July 25th and 26th (Graph 10, Table 10) indicate that the Neem treatment, Ambush treatment and the M-One and Ambush combination treatment effectively reduced flea beetle damage in the plots. The Control and the M-One treatments as well as the Ambush and M-One combination treatments, however, suffered the most damage. The level of damage by this insect remained relatively low in the experiment. Further data collected on August 14th and 15th (Graph 11, Table 11) showed that although the level of damage had increased, this level was significantly higher for the Control when compared to all other treatments.

Aphid counts collected on July 25-26 (Graph 12, Table 12) indicate that populations of both the buckthorn and the common potato aphids were effectively suppressed by the Neem, Trounce and Ambush treatments as well as the two combination treatments containing Ambush.

By August 14, 15 (Graph 13, Table 13), one month after the last spray had been applied, the Control had significantly higher populations of buckthorn aphids, and populations of Common potato aphids were significantly reduced in the Ambush treatment, only when they were compared to the M-Cap treatment.

YIELDS:

Total yield data collected on September 4th (Graph 14, Table 14) indicate that the best treatments were Ambush, M-One and Ambush combination and Ambush and M-One combination. These treatments were not significantly different however from the M-One treatment but were significantly different from all others.

Levels of damage as a consequence of feeding by Colorado Potato beetles or flea beetles were low. They were representative of the current populations in commercial potato fields in the province. Aphid pressure, although relatively high in some cases, was unlikely to have affected yields.

CONCLUSION:

It appears from the preceding that all the products and combination of products tried were generally effective at reducing larvae population of colorado potato beetles on potato plants. Of the biologicals, both Neem and Trounce showed a considerable degree of effectiveness in controlling adult stages of the beetle. They also reduced populations of the buckthorn and common potato aphids.

Trounce was phytotoxic at the dosage and frequency used. Ambush and Ambush combination treatments seemed to have had a positive effect on yields above and beyond those derived from insect control alone.

GRAPH #1

BIOLOGICAL CONTROL STUDY 1990

June 19 counts

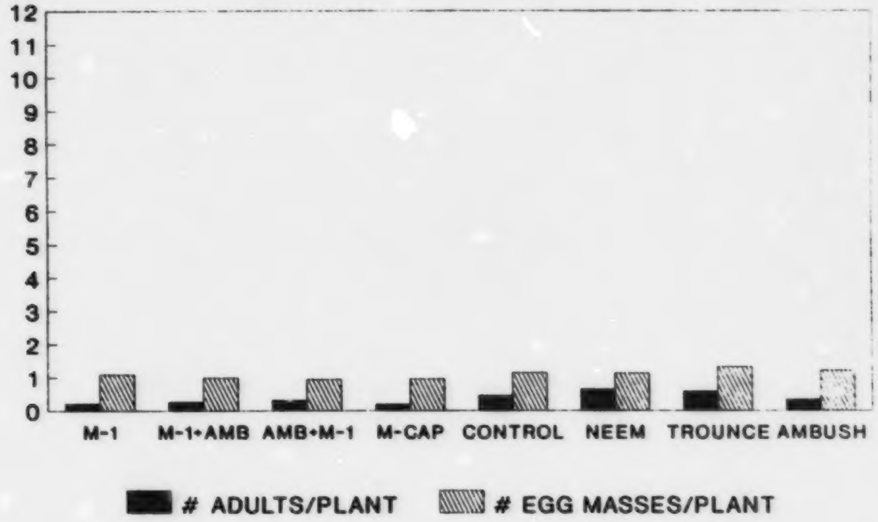


TABLE #1 JUNE 19 COUNTS (prior to the application of any spray)		
	# ADULTS/PLANTS *	**# EGG MASSES/PLANT ***
M-One	.25 bc	1.08 ab
M-One and Ambush	.26 bc	.98 b
Ambush and M-One	.31 abc	.94 b
M-Cap	.19 c	.95 b
Control	.44 abc	1.14 ab
Neem	.63 a	1.13 ab
Trounce	.56 ab	1.31 a
Ambush	.33 abc	1.20 ab

* indicates significance at .05 level

GRAPH #2

BIOLOGICAL CONTROL STUDY 1990

July 5, 6 counts

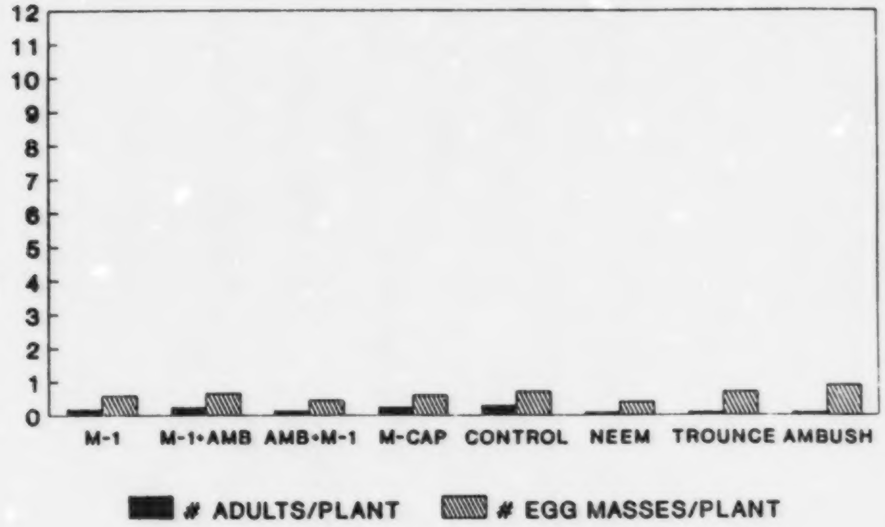


TABLE #2 JULY 5 & 6 COUNTS		
	# ADULTS/PLANTS *	# EGG MASSES/PLANT
M-One (3)	.19 abc	.58 a
M-One (3) and Ambush (0)	.23 ab	.65 a
Ambush (2) and M-One (0)	.13 bc	.43 a
M-Cap (3)	.23 ab	.61 a
Control (2)	.29 a	.69 a
Neem (2)	.07 c	.39 a
Trounce (2)	.07 c	.67 a
Ambush (2)	.08 bc	.50 a

* indicates significance at .05 level

GRAPH #3

BIOLOGICAL CONTROL STUDY 1990
July 16 counts

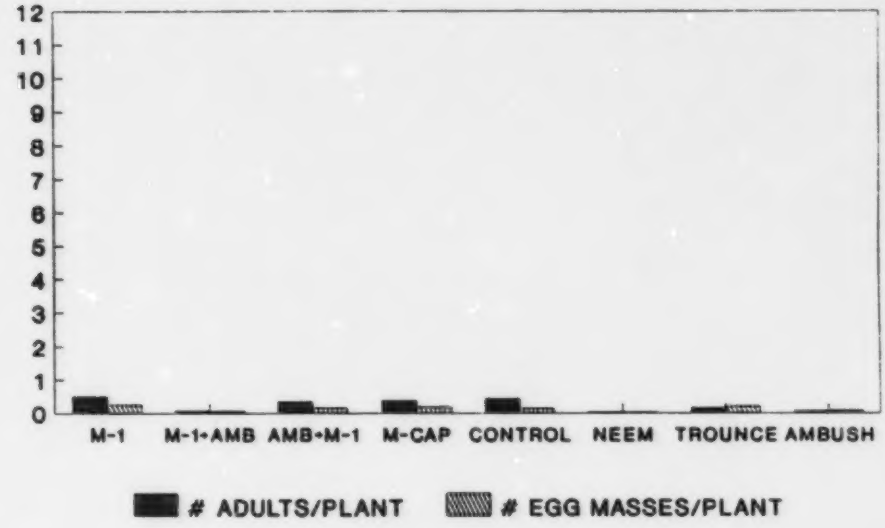


TABLE #3 JULY 16 COUNTS		
	# ADULTS/PLANTS *	# EGG MASSES/PLANT *
M-One (4)	.48 a	.26 a
M-One (3) and Ambush (1)	.08 b	.07 bc
Ambush (2) and M-One (1)	.34 a	.15 abc
M-Cap (4)	.37 a	.18 abc
Control (3)	.41 a	.12 abc
Neem (3)	.03 b	.02 c
Trounce (3)	.14 b	.20 ab
Ambush (3)	.06 b	.07 bc

* indicates significance at .05 level

GRAPH # 4

BIOLOGICAL CONTROL STUDY 1990
July 25, 26 counts

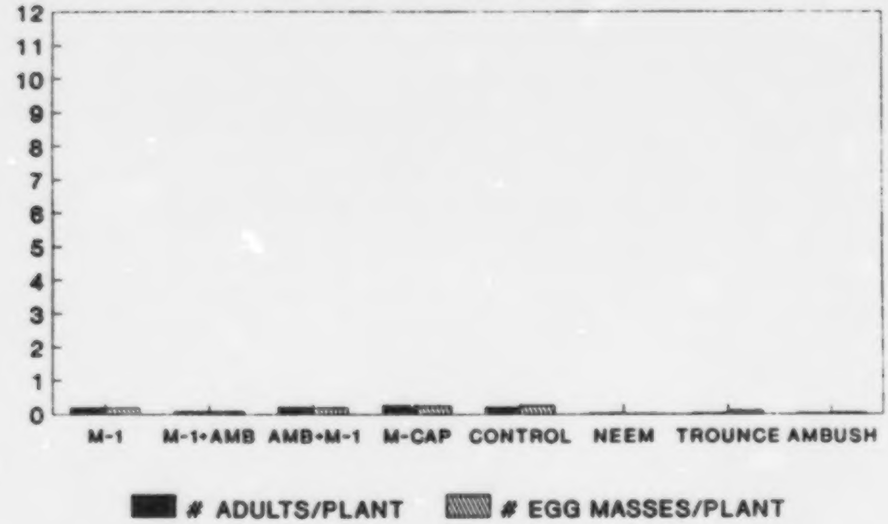


TABLE #4 JULY 25, 26 COUNTS		
	# ADULTS/PLANTS *	# EGG MASSES/PLANT *
M-One (5)	.16 ab	.18 ab
M-One (3) and Ambush (2)	.07 bc	.08 bcd
Ambush (2) and M-One (2)	.20 a	.16 abc
M-Cap (5)	.25 a	.22 a
Control (4)	.21 a	.25 a
Neem (4)	.01 c	.00 d
Trounce (4)	.03 c	.09 bcd
Ambush (4)	.02 c	.05 cd

* indicates significance at .05 level

GRAPH #5

BIOLOGICAL CONTROL STUDY 1990

August 14,15 counts

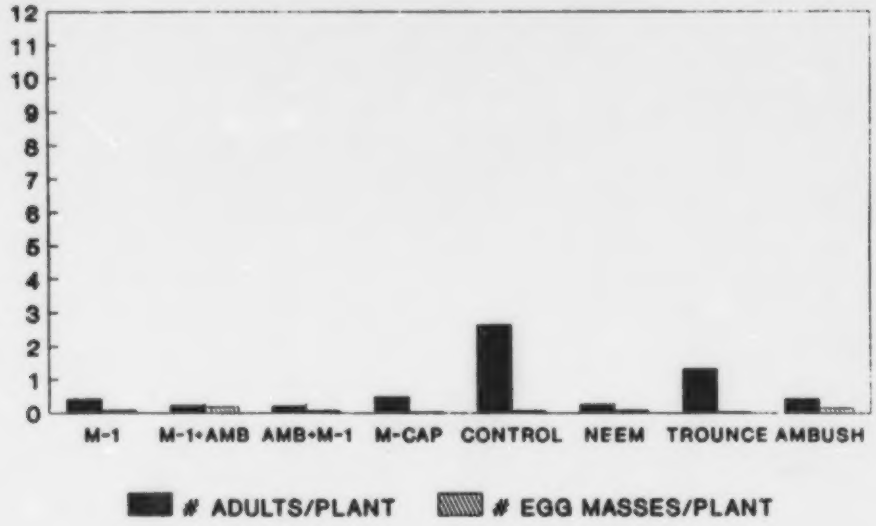


TABLE #5 AUGUST 14, 15 COUNTS		
	# ADULTS/PLANTS *	# EGG MASSES/PLANT *
M-One (5)	.40 b	.07 ab
M-One (3) and Ambush (2)	.21 b	.17 a
Ambush (2) and M-One (2)	.21 b	.06 ab
M-Cap (5)	.47 b	.03 b
Control (4)	2.62 a	.06 ab
Neem (4)	.26 b	.07 ab
Trounce (4)	1.30 b	.02 b
Ambush (4)	.42 b	.15 a

* indicates significance at .05 level

GRAPH #6

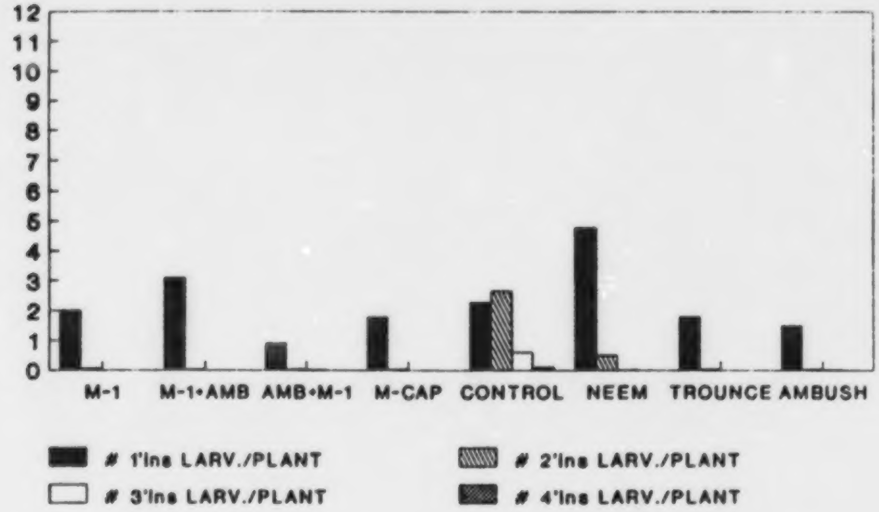

BIOLOGICAL CONTROL STUDY 1990
July 5, 6 counts

TABLE #6 JULY 5, 6 COUNTS				
	# Larvae/Plant			
	1st instar *	2nd instar *	3rd instar *	4th instar
M-One (3)	1.99 b	.05 b	.00 b	.00 a
M-One (3) and Ambush (0)	3.08 ab	.03 b	.00 b	.00 a
Ambush (2) and M-One (0)	.89 b	.04 b	.01 b	.00 a
M-Cap (3)	1.77 b	.02 b	.00 b	.00 a
Control (2)	2.26 b	2.65 a	.61 a	.11 a
Neem (2)	4.765 a	.50 b	.01 b	.00 a
Trounce (2)	1.78 b	.02 b	.00 b	.00 a
Ambush (2)	1.40 b	.04 b	.00 b	.00 a

* indicates significance at .05 level

GRAPH #7

BIOLOGICAL CONTROL STUDY 1990
July 16 counts

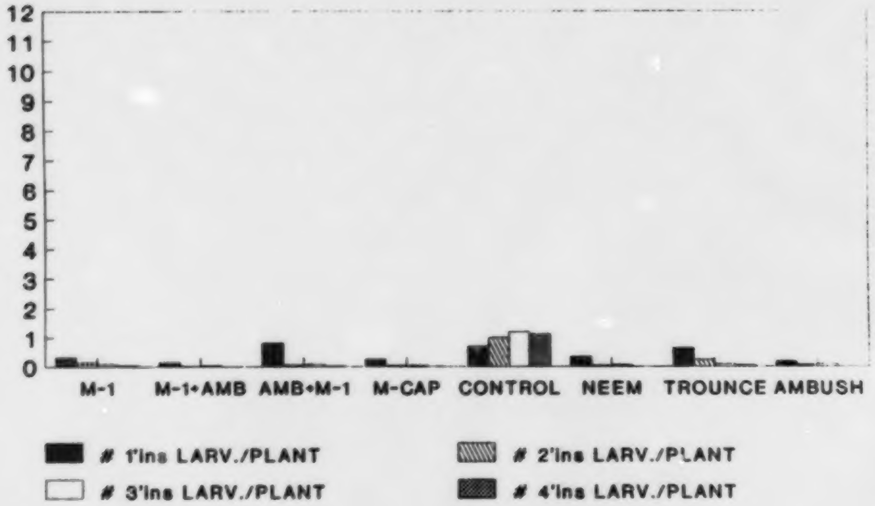


TABLE #7 JULY 16, COUNTS				
	# Larvae/Plant			
	1st instar	2nd instar *	3rd instar *	4th instar *
M-One (4)	.24 a	.12 b	.06 b	.04 b
M-One (3) and Ambush (1)	.13 a	.00 b	.02 b	.00 b
Ambush (2) and M-One (1)	.80 a	.05 b	.08 b	.01 b
M-Cap (4)	.25 a	.04 b	.02 b	.00 b
Control (3)	.67 a	1.00 a	1.20 a	1.11 a
Neem (3)	.32 a	.03 b	.06 b	.00 b
Trounce (3)	.61 a	.22 b	.06 b	.10 b
Ambush (3)	.18 a	.05 b	.07 b	.00 b

* indicates significance at .05 level

GRAPH #8

BIOLOGICAL CONTROL STUDY 1990
July 25, 26 counts

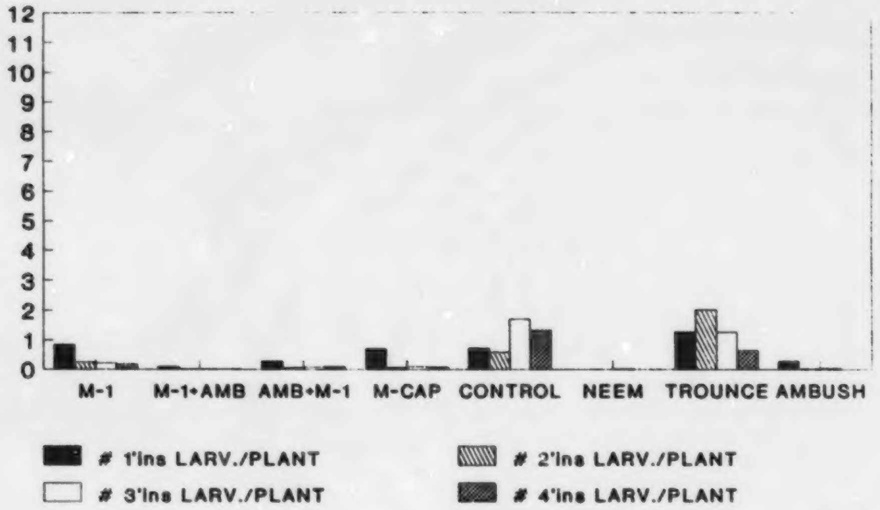


TABLE #8
JULY 25, 26, COUNTS

	# Larvae/Plant			
	1st instar *	**2nd instar ***	**3rd instar ***	**4th instar ***
M-One (5)	.74 ab	.26 b	.21 b	.17 bc
M-One (3) and Ambush (2)	.09 ab	.01 b	.01 b	.00 c
Ambush (2) and M-One (2)	.27 ab	.04 b	.08 b	.09 c
M-Cap (5)	.70 ab	.06 b	.09 b	.07 c
Control (4)	.70 ab	.57 b	1.69 a	1.16 a
Neem (4)	.00 b	.00 b	.00 b	.00 c
Trounce (4)	1.26 a	2.01 a	1.26 a	.65 b
Ambush (4)	.27 ab	.01 b	.03 b	.00 c

*** indicates significance at .05 level**

GRAPH #9

BIOLOGICAL CONTROL STUDY 1990

August 14,15 counts

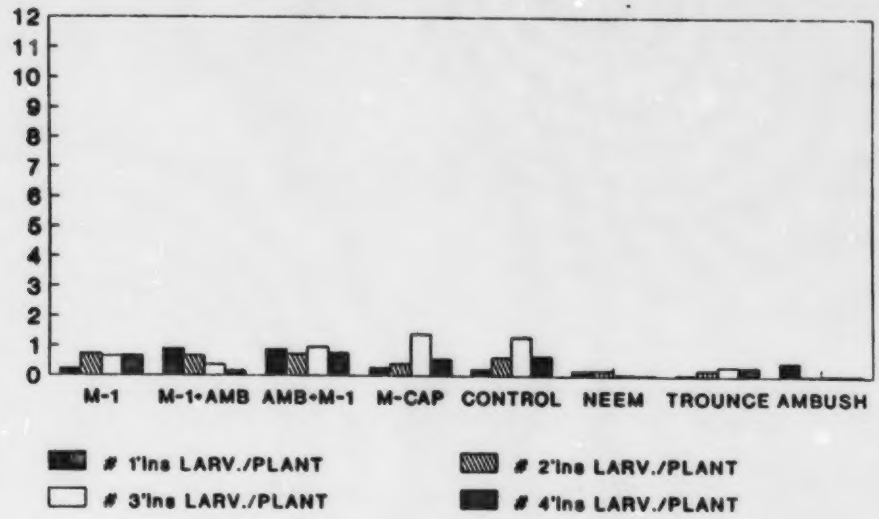


TABLE #9 AUGUST 14, 15 COUNTS				
	# Larvae/Plant			
	1st instar *	2nd instar *	3rd instar *	4th instar *
M-One (5)	.27 bc	.71 a	.64 bcd	.65 abc
M-One (3) and Ambush (2)	.90 a	.66 a	.35 cd	.16 cd
Ambush (2) and M-One (2)	.86 ab	.73 a	.95 abc	.75 ab
M-Cap (5)	.27 bc	.41 ab	1.39 a	.55 abcd
Control (4)	.23 c	.62 a	1.30 ab	.88 a
Neem (4)	.19 c	.19 ab	.05 d	.03 d
Trounce (4)	.05 c	.21 ab	.32 cd	.31 bcd
Ambush (4)	.46 abc	.04 b	.03 d	.05 d

* indicates significance at .05 level

GRAPH #10

BIOLOGICAL CONTROL STUDY 1990
FLEA BEETLE DAMAGE (JULY 25 & 26)

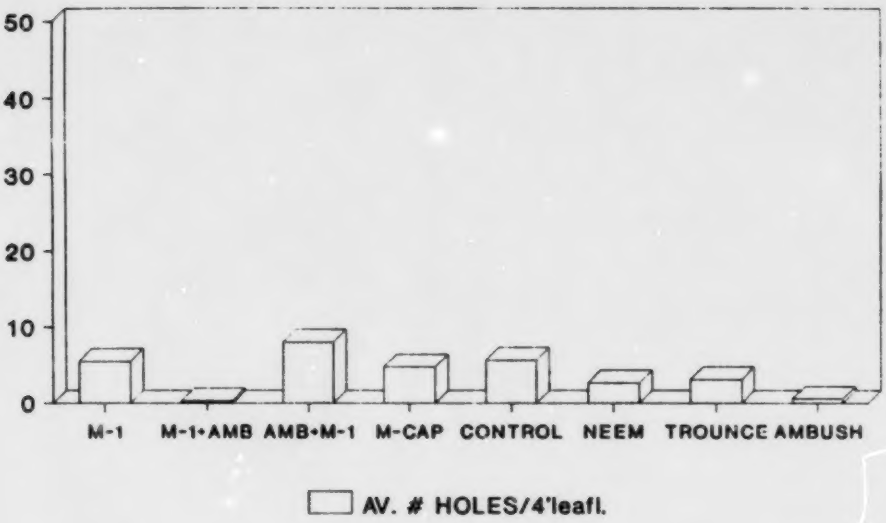


TABLE #10 JULY 25, 26 COUNTS	
	Flea Beetle Damage *
	# holes/4th leaflet
M-One (5)	5.50 ab
M-One (3) and Ambush (2)	.30 c
Ambush (2) and M-One (2)	8.00 a
M-Cap (5)	4.77 bc
Control (4)	5.65 ab
Neem (4)	2.65 cde
Trounce (4)	3.10 bcd
Ambush (4)	.57 de

* indicates significance at .05 level

GRAPH #11

BIOLOGICAL CONTROL STUDY 1990
FLEA BEETLE DAMAGE (AUG. 14 & 15)

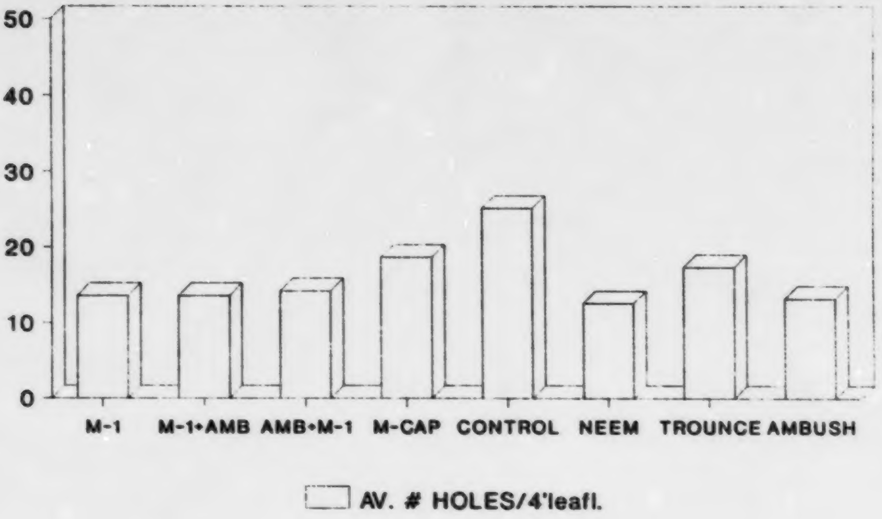


TABLE #11
AUGUST 14, 15 COUNTS

	Flea Beetle Damage *
	# holes/4th leaflet
M-One (5)	13.60 b
M-One (3) and Ambush (2)	13.55 b
Ambush (2) and M-One (2)	14.22 b
M-Cap (5)	18.57 b
Control (4)	25.10 a
Neem (4)	12.55 b
Trounce (4)	17.27 b
Ambush (4)	13.17 b

* indicates significance at .05 level

GRAPH #12

BIOLOGICAL CONTROL STUDY 1990
JULY 25 & 26 APHID COUNTS

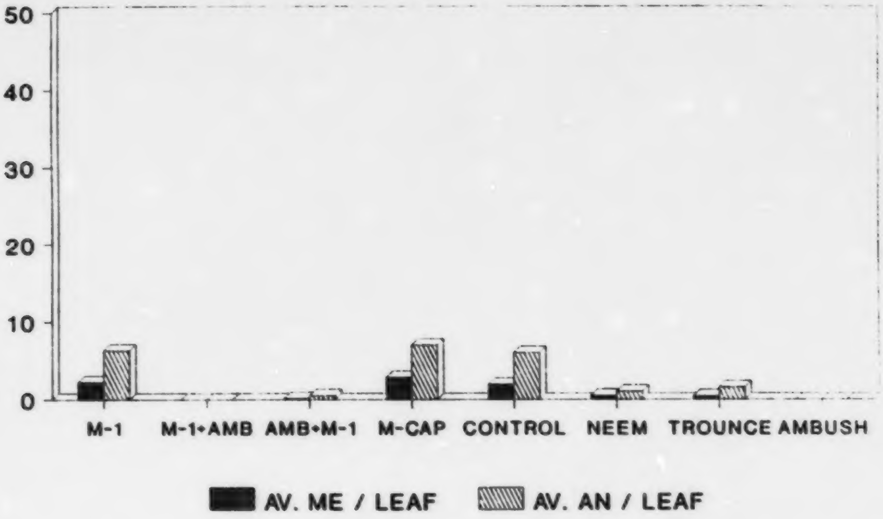


TABLE #12 JULY 25, 26 COUNTS		
	# Aphids/Leaf *	
	Buckthorn (An.)	Common Potato (Me.)
M-One (5)	6.30 a	2.27 a
M-One (3) and Ambush (2)	.02 b	.00 b
Ambush (2) and M-One (2)	.52 b	.12 b
M-Cap (5)	6.97 a	2.82 a
Control (4)	6.00 a	1.97 a
Neem (4)	1.07 b	.50 b
Trounce (4)	1.55 b	.47 b
Ambush (4)	.00 b	.00 b

* indicates significance at .05 level

GRAPH #13

BIOLOGICAL CONTROL STUDY 1990
AUG. 14 & 15 APHID COUNTS

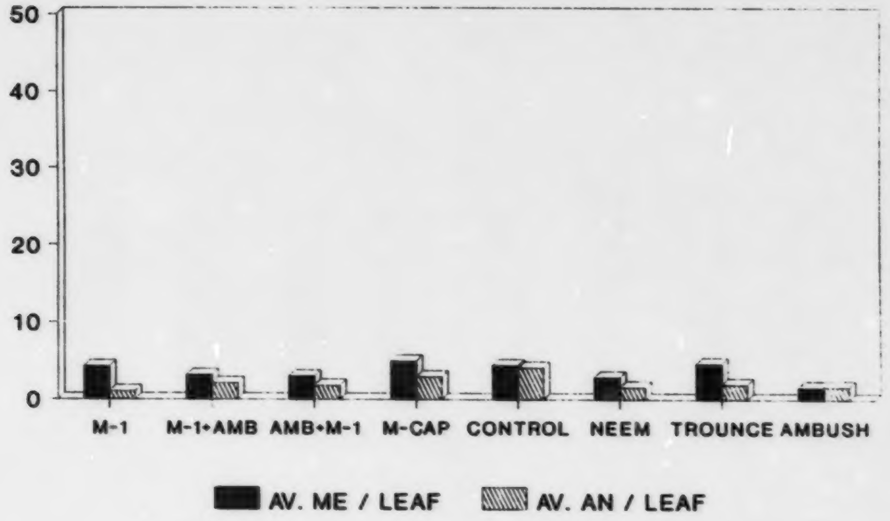


TABLE #13 AUGUST 14, 15 COUNTS		
	# Aphids/Leaf *	
	Buckthorn (An.)	Common Potato (Me.)
M-One (5)	1.05 b	4.25 ab
M-One (3) and Ambush (2)	2.12 b	3.12 ab
Ambush (2) and M-One (2)	1.82 b	3.00 ab
M-Cap (5)	2.92 b	4.95 a
Control (4)	4.15 a	4.45 ab
Neem (4)	1.57 b	2.85 ab
Trounce (4)	1.97 b	4.62 ab
Ambush (4)	1.65 b	1.55 b

* indicates significance at .05 level

GRAPH #14

BIOLOGICAL CONTROL STUDY 1990

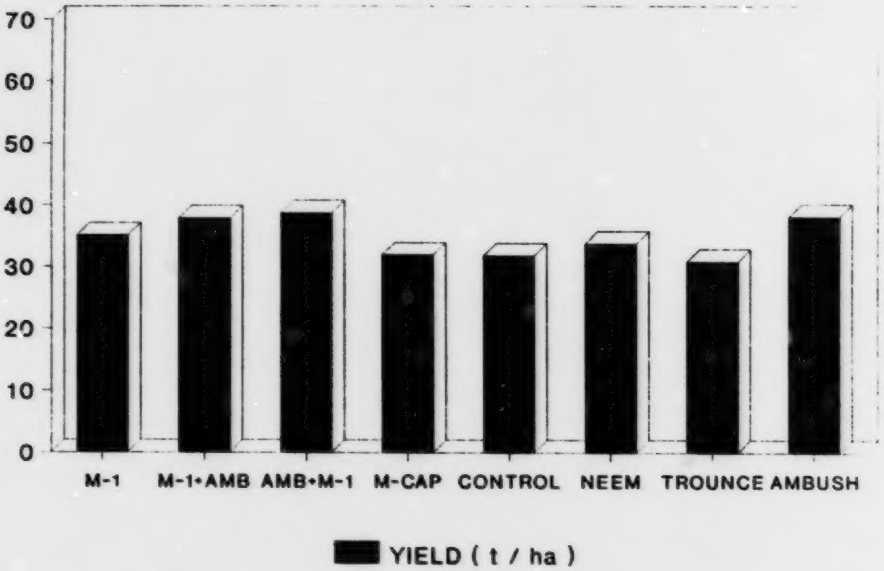


TABLE #14

	YIELD (T/HA) *
M-One	35.12 ab
M-One and Ambush	37.88 a
Ambush and M-One	38.75 a
M-Cap	31.92 bc
Control	31.80 bc
Neem	33.72 bc
Trounce	30.82 c
Ambush	38.19 a

* indicates significance at .05 level

THE EVALUATION OF LIQUID ACID FERTILIZER IN POTATO PRODUCTION FOR NEW BRUNSWICK

G. J. Pelletier

ABSTRACT

With the introduction of a liquid acid fertilizer in the Upper Saint John River Valley in the spring of 1989, some 6 to 7 potato growers fertilized their entire crop with this product, representing some 600 hectares. Many other growers were also interested by the program but took the wait and see approach. This study was initiated in 1990 to assess the impact of the "new" fertilizer program on potato yields and quality in New Brunswick.

The program was investigated in a split plot design using four replicates, four rates (0 l/ha, 107 l/ha, 213 l/ha and 427 l/ha) of liquid acid fertilizer (5-20-0-2%S) along with the check consisting of 899 kg/ha of 15-10-15 were used as main treatments. Two mid-season varieties, Shepody and Russet Norkotah, were used as the split treatment.

Reduced marketable yield of 6% (not statistically significant) for Shepody and 21% (statistically significant) for Russet Norkotah, a significantly reduced plant stand at the highest rate of the liquid acid fertilizer for Russet Norkotah and a smaller plant development were associated with the use of the liquid acid fertilizer program. However, an earlier plant emergence was observed with the liquid acid fertilizer program.

ÉVALUATION DE LA FERTILISATION À BASE D'ENGRAIS LIQUIDE ACIDE POUR LA PRODUCTION DE POMMES DE TERRE AU NOUVEAU-BRUNSWICK

RÉSUMÉ

Avec l'introduction de l'engrais liquide acide dans le haut de la vallée de la rivière Saint-Jean au printemps 1989, quelques 6 à 7 producteurs ont fertilisé toute leur culture avec ce produit, ce qui représentait environ 600 hectares. Plusieurs autres producteurs ont été intéressés par ce programme, mais ils ont plutôt opté d'attendre pour en connaître les résultats. Cette étude à été entreprise en 1990 pour évaluer l'impact de ce "nouveau" programme de fertilisation sur les rendements et la qualité de la pomme de terre.

Quatre taux (0 l/ha, 107 l/ha, 213 l/ha et 427 l/ha) d'engrais liquide acide (analyse de 5-20-0-2%S) avec le traitement témoin de 899 kg/ha de 15-10-15 ont été appliqués. Deux variétés mi-saison, Shepody et Russet Norkotah, ont été utilisées dans cet essai.

Une réduction des rendements vendables de 6% (statistiquement non-significative) pour Shepody et de 21% (statistiquement significative) pour Russet Norkotah, une augmentation significative des manques à la levée pour Russet Norkotah avec le plus haut taux de l'engrais liquide acide et l'obtention de plantes plus petites ont tous été associés à l'utilisation du programme liquide acide. Cependant, on a remarqué une émergence plus rapide avec certains traitements d'engrais liquide acide.

THE EVALUATION OF LIQUID ACID FERTILIZER IN POTATO PRODUCTION FOR NEW BRUNSWICK

INTRODUCTION

The utilization of a liquid acid starter fertilizer was introduced to New Brunwick potato growers in the spring of 1989. The product is marketed by Stoller Canada Chemical Company Ltd. with a local distributor located in the Grand Falls area. Claims of improved potato yield and quality, with a greater net return per hectare encouraged some 6 to 7 potato growers in the potato belt to fertilize their entire crop using the liquid acid program in 1989.

The liquid acid fertilizer is a fluid fertilizer with a pH less than 4, usually in the 1 to 3 range, consisting of urea in combination with phosphoric acid and sulphuric acid. A 5-20-0-2 S analysis is being manufactured and sold locally. A rate of 213 l/ha of 5-20-0-2 S which represents 14.4, 55.5 and 5.8 kg/ha of actual N, P_2O_5 and Sulphur respectively is being recommended by the local manufacturer for early and mid-season varieties. The liquid is applied in a band immediately following the opening shoes of the planter before the seed pieces are dropped. Thus, the liquid band is localized underneath the seed pieces. All of the K_2O (muriate of potash source) requirement is broadcasted and harrowed in prior to planting along with some of the nitrogen (ammonium nitrate source) requirement. The remainder of the nitrogen (ammonium nitrate source) requirement is broadcasted prior to hilling. Instead of the ammonium nitrate, a producer could use a N-hib-Ca liquid fertilizer product, a Stoller Canada Chemical Company Ltd. product, at hilling time.

The claimed benefits of the liquid acid starter fertilizer are as follow:

1. More efficient use of nitrogen as more nitrogen remains in ammoniacal form (especially true when the N-hib-Ca product is used).

2. More efficiency from P_2O_5 (up to 50% compared to 15% for DAP) as orthophosphoric acid is used in the manufacture of the liquid acid fertilizer.

3. Create an "acid zone" around the plant's root which supplies to the plant a steady source of non-mobile nutrients.

4. Low pH (1 to 3), therefore lower cost secondary and micronutrients can be utilized.

5. Liquids offer ease of secondary and micronutrients addition in liquid forms, providing a homogeneous blend.

6. Acidifying the soil zone with band application increases the uptake of phosphorus and divalent metals (micronutrients).

7. Liquids move into the soil moisture surrounding the seed and unlike granules, they do not require moisture to be dissolved.

8. Low salt index: can be placed in close proximity to the seed allowing full fertilization at planting time saving the farmer both money and time.

9. Encourage the development of a more extensive root system

10. Safe and easy to handle, easy for farmers to apply, saving the cost of custom application equipment.

11. Low equipment cost. Polyethylene tanks are versatile and inexpensive, squeeze pumps are economical and accurate for application.

12. Easy handling, greater accuracy in rates and time and labour saving.

13. Increases yields for more farmer profit.

This study was initiated to assess the impact of this new technology on potato yields and quality in New Brunswick.

MATERIALS AND METHODS

A split plot design was used for the experiment utilizing four replicates. A fifth replicate was used to sample potato plants in order to determine the growth rate of various plant components.

The main 5 treatments are described in Table 1.

Two mid-season varieties, Shepody and Russet Norkotah, were used as the split treatment.

The plot was established on a gravelly clay loam soil cropped in spring cereals in 1989. Soil analysis results are presented in Table 2.

Table 1. *Description of fertilizer treatments*

TREATMENTS		N			P_2O_5			K_2O		
		Kg/ha	Source	Application	Kg/ha	Source	Application	Kg/ha	Source	Application
1.	0 l/ha liquid of 5-20-0	67.5	AN	BHP	0	-	-	135.0	M of P	BHP
		67.5	AN	SDH						
		135.0								
2.	107 l/ha of liquid 5-20-0	67.5	AN	BHP	27.8	LAF	BSF	135.0	M of P	BHP
		7.2	LAF	BSF						
		60.3	AN	SDH						
		135.0								
3.	213 l/ha of liquid 5-20-0	67.5	AN	BHP	55.5	LAF	BSF	135.0	M of P	BHP
		14.4	LAF	BSF						
		53.1	AN	SDH						
		135.0								
4.	427 l/ha of liquid 5-20-0	67.5	AN	BHP	111.0	LAF	BSF	135.0	M of P	BHP
		28.8	LAF	BSF						
		38.7	AN	SDH						
		135.0								
5.	899 kg/ha of granular 15-10-15	99.0	AN	DBP	89.9	DAP	DBP	135.0	M of P	DBP
		36.0	DAP							
		135.0								

Legend of Source:

AN - Ammonium nitrate
DAP - Diammonium phosphate
LAF - Liquid acid fertilizer
M of P - Muriate of potash

Application

BHP - Broadcasted and harrowed in prior to planting
BSF - Banded under seed in furrow at planting
DBP - Double bands at planting
SDH - Side dressed prior to last hilling

Fertilizer treatments were applied on May 15, 1990 and foundation cut seed was planted on the following day at 30.5 cm in row spacing on rows 91 cm apart. Main plots measured 11.6 m long with 4 rows wide.

Two adjacent rows were planted with Shepody, the other two adjacent rows were planted with Russet Norkotah.

Composite soil samples were taken before fertilizer application and after harvesting.

Emergence counts were taken 2 to 3 times per week to determine emergence curves and the final plant stand.

Composite leaf samples, representing the 3rd to 4th leaf from the top of the plant to assess the mineral nutritional status were taken between 50 to 55 days after planting.

Four plants per variety for each of the fertilizer treatments were pulled out from the fifth replicate on a weekly basis to determine various plant components growth rate.

Table 2. Mean soil analysis of different fertilizer treatments prior to fertilizer/planting and after harvesting (brackets).

TREATMENTS	Soil Analysis					
	pH	O.M.%	P$_{(2)}$0$_{(5)}$ (Kg/ha	K$_{(2)}$0 (Kg/ha)	Ca (Kg/ha)	Mg (Kg/ha)
0 l/ha	6.0 (6.4)	2.7 (2.5)	513+ (513+)	249 (308)	1673 (1454)	166 (136)
107 l/ha	6.0 (6.0)	2.9 (2.9)	513 (513+)	269 (313)	1764 (1445)	153 (147)
213 l/ha	6.0 (6.3)	2.7 (2.8)	513+ (513+)	248 (262)	1819 (1770)	187 (152)
427 l/ha	6.0 (6.3)	3.0 (2.9)	513+ (513+)	280 (513+)	1541 (1553)	171 (171)
15-10-15	6.1 (6.5)	2.8 (2.6)	513+ (513+)	274 (267)	1899 (1662)	152 (135)

Content for all treatments tend to be similar.

Recommended commercial cultural practices were carried out throughout the growing season. The plot was topkilled on September 7 with the application of Diquat. The two inner rows of the main plots, one of each variety, were harvested on September 25. Potatoes were graded in the following categories: smalls - less than 5.1 cm in diameter; medium size - from 5.1 cm in diameter to 284 grams in weight; large - over 284 grams in weight and off type - to Canada N^0 1 standards.

Specific gravity was determined using the hydrometer method (3.63 kg of potatoes). Sugar content and fry colour testing was performed for the variety Shepody only.

RESULTS AND DISCUSSION

Soil Chemical Analysis

Results of soil chemical analysis are reported in Table 2.

pH readings for the before fertilizer application samples are very similar for all fertilizer treatments with a pH ranging from 6.0 to 6.1. However, the readings for the after harvest samples are more spread apart, varying from 6.0 to 6.5. There is no apparent relationship between the amount of liquid acid fertilizer applied and the pH variation between the before fertilizer application samples and the after harvest samples.

All of the other chemical soil components are very uniform across all the fertilizer treatments and there is very little variation from the before fertilizer application samples and the after harvest samples.

Emergence rate and final plant stand

Emergence curves for Russet Norkotah and Shepody are plotted in Figures 1 and 2 respectively.

For both varieties, the granular (15-10-15) fertilizer treatment lag behind in emergence. For Russet Norkotah, the 427 l/ha liquid acid fertilizer treatment favoured a quicker emergence followed by the 213 l/ha which was similar to the 107 l/ha, followed by the 0 l/ha liquid acid fertilizer treatments. The earlier emergence for Shepody was obtained with the 107 l/ha, followed by the 213 l/ha, 427 l/ha and the 0 l/ha liquid acid fertilizer treatments.

The final plant stand is illustrated in Figure 3. The final plant stand for Shepody was very good, ranging from 99% to 100% with no significant difference between the fertilizer treatments. However, a significantly lower plant stand was obtained with the highest liquid acid fertilizer rate treatment for Russet Norkotah.

The earlier emergence (.25 to 1 day) observed with the liquid acid fertilizer may be attributed to a more readily available source of plant nutrients than with the granular fertilizer which need to be dissolved into the soil moisture before becoming available to the potato plant. However the lower final plant stand observed for the highest rate of liquid acid fertilizer for the Russet Norkotah variety may suggest some phytotoxicity effects.

Plant nutritional status

Plant tissue nutrients content are presented in Figures 4 to 9.

FIG. 1 EFFECT OF FERTILIZER TREATMENTS ON THE EMERGENCE OF RUSSET NORKOTAH

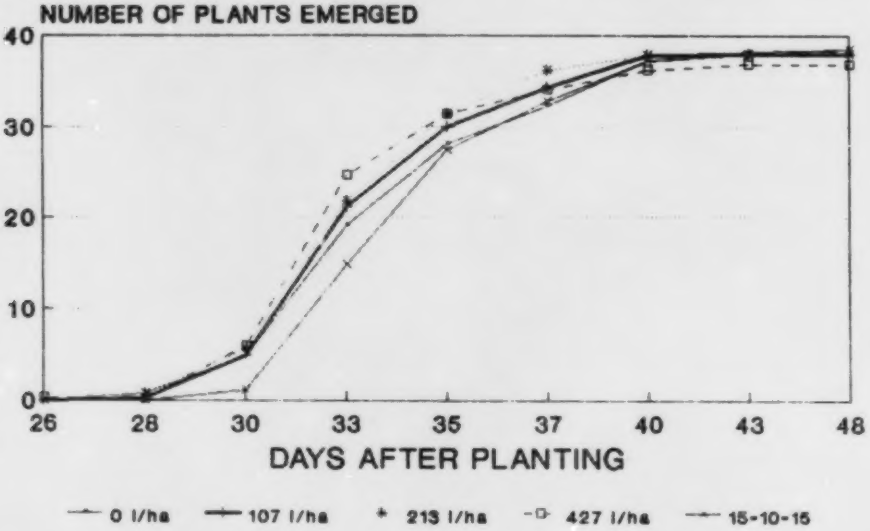


FIG. 2 EFFECT OF FERTILIZER TREATMENTS ON THE EMERGENCE OF SHEPODY

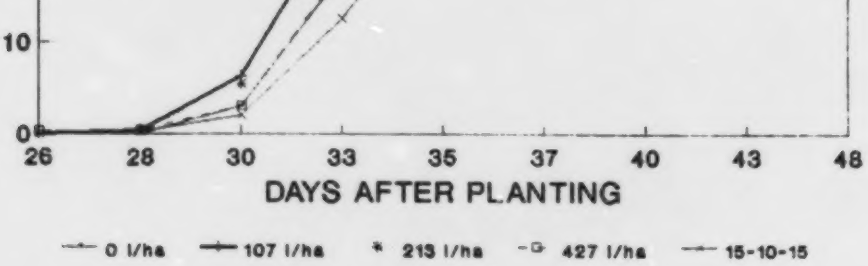
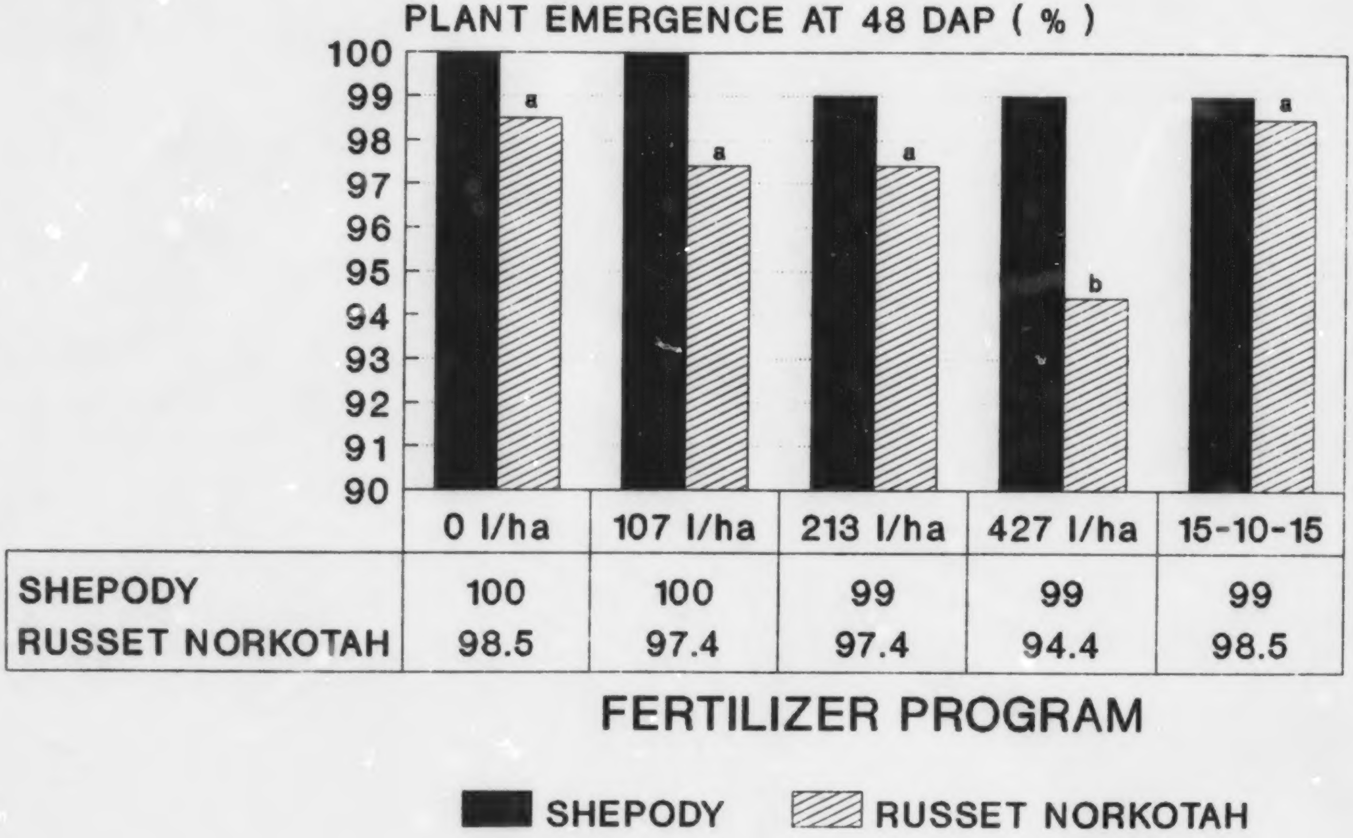


FIG. 3 EFFECT OF FERTILIZER TREATMENTS ON THE FINAL PLANT STAND OF SHEPODY AND RUSSET NORKOTAH



	0 l/ha	107 l/ha	213 l/ha	427 l/ha	15-10-15
SHEPODY	100	100	99	99	99
RUSSET NORKOTAH	98.5	97.4	97.4	94.4	98.5

FIG. 4 TISSUE NITROGEN CONTENT IN RUSSET NORKOTAH WITH DIFFERENT FERTILIZER TREATEMENTS

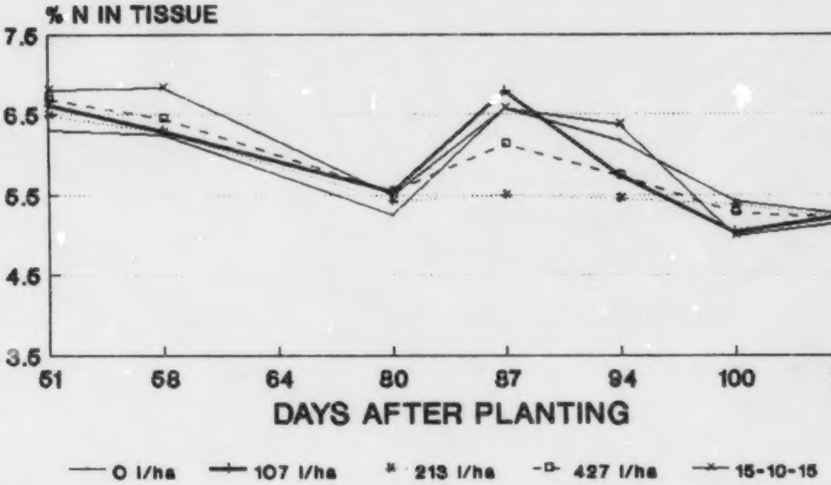


FIG. 5 TISSUE NITROGEN CONTENT IN SHEPODY WITH DIFFERENT FERTILIZER TREATEMENTS

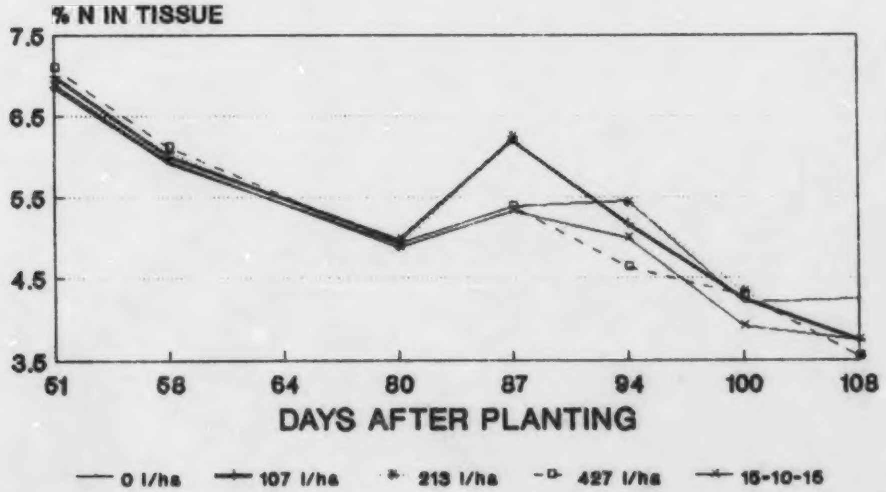


FIG. 6 TISSUE PHOSPHORUS CONTENT IN RUSSET NORKOTAH WITH DIFFERENT FERTILIZER TREATMENTS

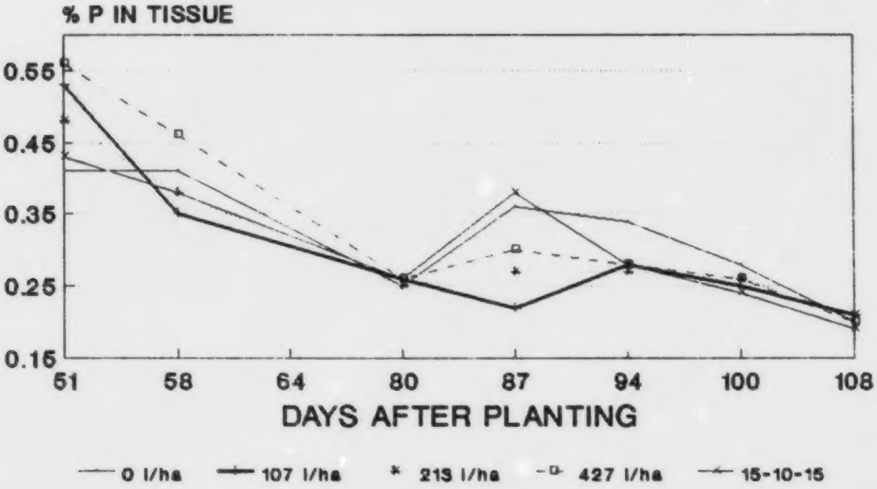


FIG. 7 TISSUE PHOSPHORUS CONTENT IN SHEPODY WITH DIFFERENT FERTILIZER TREATMENTS

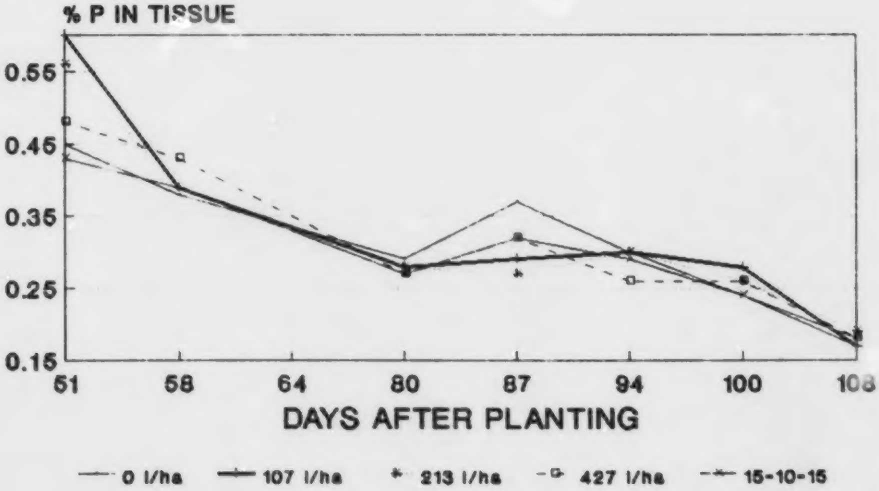


FIG. 8 TISSUE POTASSIUM CONTENT IN RUSSET NORKOTAH WITH DIFFERENT FERTILIZER TREATMENTS

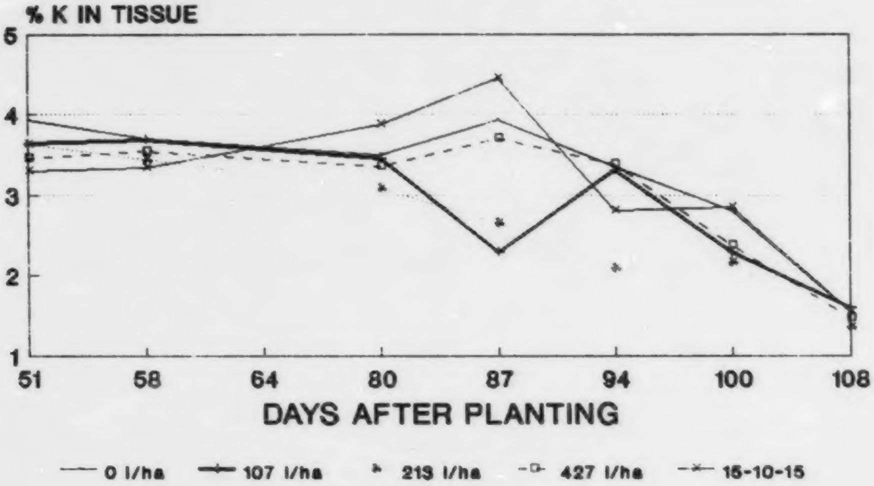
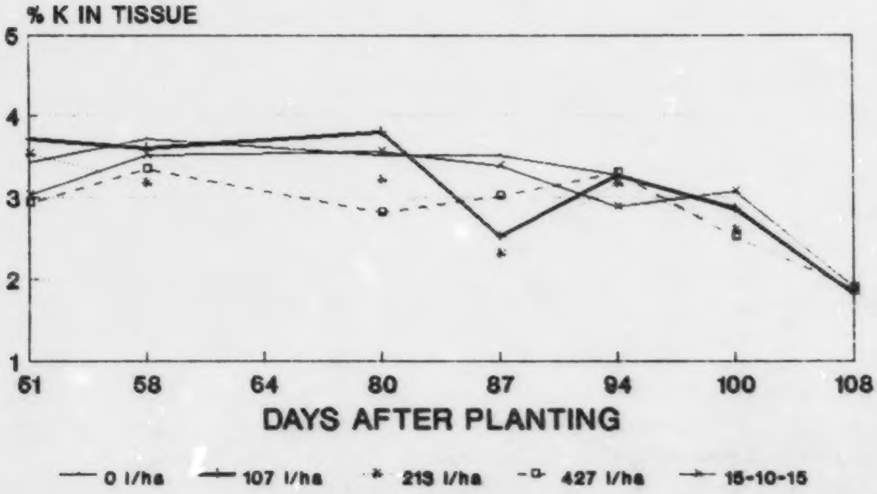


FIG. 9 TISSUE POTASSIUM CONTENT IN SHEPODY WITH DIFFERENT FERTILIZER TREATMENTS



% N in tissue

Nitrogen content in Russet Norkotah was higher in the granular (15-10-15) fertilizer treatment early in the season than any of the liquid acid fertilizer treatments. The drop observed in 80 DAP samples followed by a sudden increase in the 87 DAP follows the precipitation pattern experienced during that period.

Knowing that the only difference in nitrogen fertilization between treatments is that all of the nitrogen was band placed at planting for the granular (15-10-15) fertilizer treatment while mostly all of the nitrogen was broadcasted in a split applications for the liquid acid fertilizer treatments it can be argued that the higher nitrogen content early in the season in the granular (15-10-15) treatment is due to a better recovery by the potato plant of the band applied nitrogen. At the end of the growing season, a lower nitrogen content is observed for the granular (15-10-15) fertilizer treatment than for the liquid acid fertilizer treatments. The split application of nitrogen associated with the liquid acid treatment may have provided more nitrogen at the end of the growing season; while for the case of the granular (15-10-15) fertilizer treatment with all of the nitrogen requirement applied at planting time, some nitrogen applied may have been loss by leaching.

The observations made for Shepody are somewhat different. No difference in the nitrogen content was observed during the first part of the growing season. Shepody, with a more extensive root system than Russet Norkotah, may be able to better use the broadcasted nitrogen fertilizer than Russet Norkotah. As with Russet Norkotah, the nitrogen content at the end of the growing season had a tendency to be lower with the granular (15-10-15) fertilizer treatment than for the liquid acid fertilizer treatments, suggesting a better recovery of nitrogen with the split application than the one full rate application at planting time.

% P in tissue

Similar tends for both varieties were observed in respect to the tissue phosphorus content. Earlier in the season, both granular (15-10-15) fertilizer and the 0 l/ha liquid acid fertilizer treatments had the lowest content of phosphorus. The greater and earlier availability of phosphorus from the liquid acid fertilizer may be responsible for this difference. However, as the season progresses, phosphorus

% K in tissue

Generally, the potassium content for both varieties started lower for the granular (15-10-15) fertilizer treatment than for the liquid acid fertilizer treatment with the exception of the highest liquid acid fertilizer rate. However, by the end of the growing season, potassium content in the granular (15-10-15) fertilizer treatment was higher than most of the liquid fertilizer treatments.

This was more obvious for Russet Norkotah than for Shepody. Again, with the small root system for Russet Norkotah, the localized band placement of potash fertilizer may be superior to the broadcast method of application

Plant growth rate

Plant components growth rates are presented in Figures 10 to 15.

Foliage Growth Rate

Russet Norkotah

At the beginning of the growing season, the foliage growth rate, as expressed by fresh weight per plant, tend to be slower for the granular (15-10-15) fertilizer treatment along with the 0 l/ha and the 427 l/ha liquid acid fertilizer treatments than for the 213 l/ha and 107 l/ha liquid fertilizer treatments. The 0 l/ha liquid acid fertilizer treatment had the smallest foliage growth throughout the season followed by the 213 l/ha, the 107 l/ha and the 427 l/ha liquid fertilizer treatments. After 64 DAP, the granular (15-10-15) fertilizer treatment had the largest foliage development.

Shepody

The 0 l/ha liquid acid fertilizer treatment had the smallest foliage growth for the large part of the season. All of the other treatments gave similar foliage development. Foliage growth for Shepody was considerably higher than for Russet Norkotah. None of the fertilizer treatments provided enough foliage growth for Russet Norkotah to close the rows. From these observations, it appears that foliage growth for both varieties was stimulated by the application of phosphorus in the fertilizer program.

Root growth rate

The variation between sampling dates exceeded the differences between the fertilizer treatments observed for both varieties. However, Shepody had a larger root system than Russet Norkotah.

Tuber growth rate

Russet Norkotah

The 0 l/ha liquid acid fertilizer treatment had the lowest tuber growth rate. The granular (15-10-15) fertilizer treatment had the highest growth rate, followed closely by the 427 l/ha, the 213 l/ha and the 107 l/ha liquid acid fertilizer treatments. The trends observed with the tuber growth rate reassemble those of the foliage growth patterns.

FIG. 10 FOLIAGE GROWTH RATE FOR RUSSET NORKOTAH WITH DIFFERENT FERTILIZER TREATMENTS

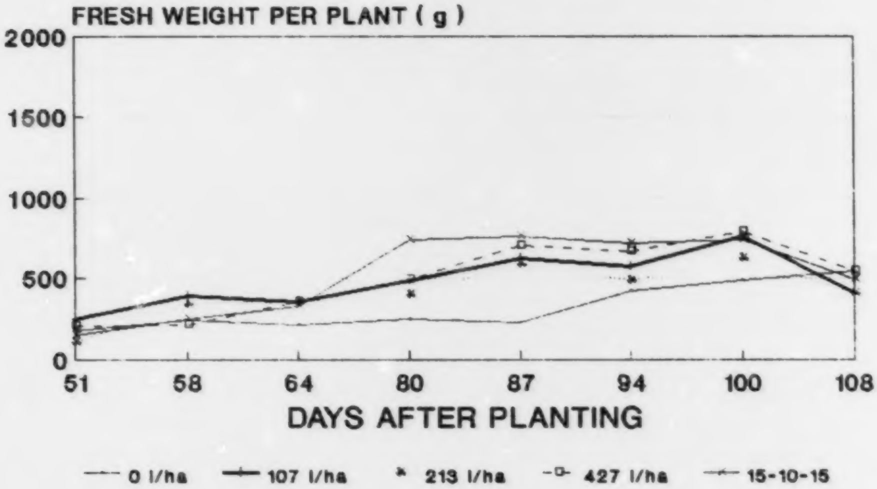


FIG. 11 FOLIAGE GROWTH RATE FOR SHEPODY WITH DIFFERENT FERTILIZER TREATMENTS

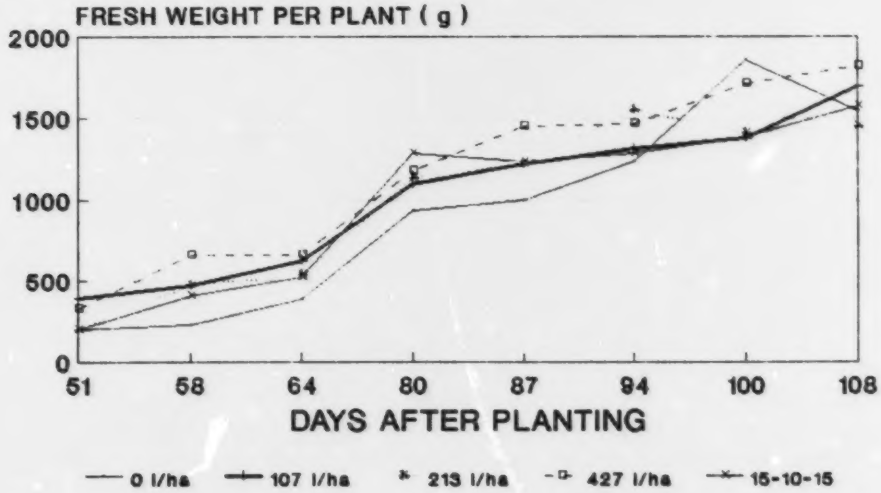


FIG. 12 ROOT GROWTH RATE FOR RUSSET NORKOTAH WITH DIFFERENT FERTILIZER TREATMENTS

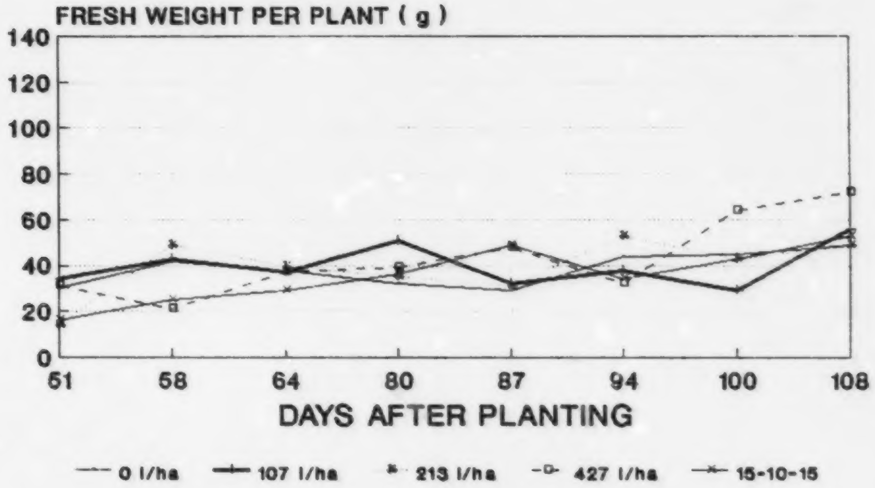


FIG. 13 ROOT GROWTH RATE FOR SHEPODY WITH DIFFERENT FERTILIZER TREATMENTS

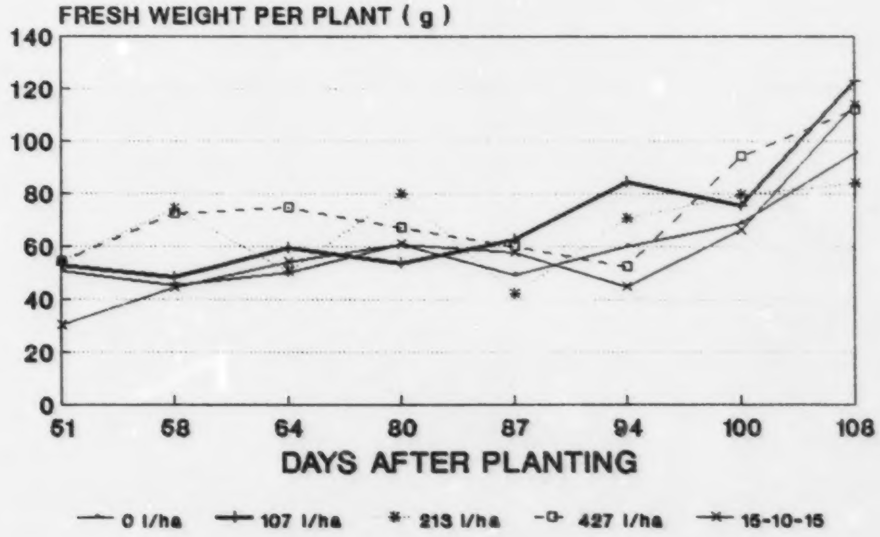


FIG. 14 TUBER GROWTH RATE FOR RUSSET NORKOTAH WITH DIFFERENT FERTILIZER TREATMENTS

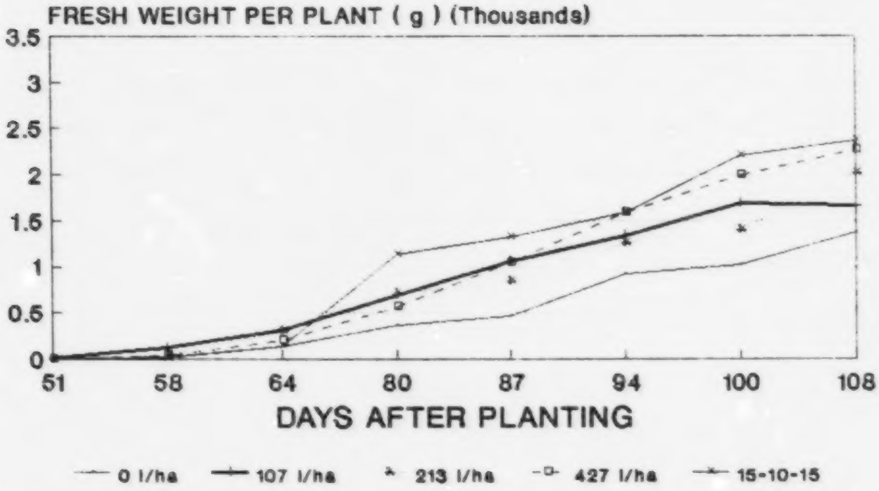
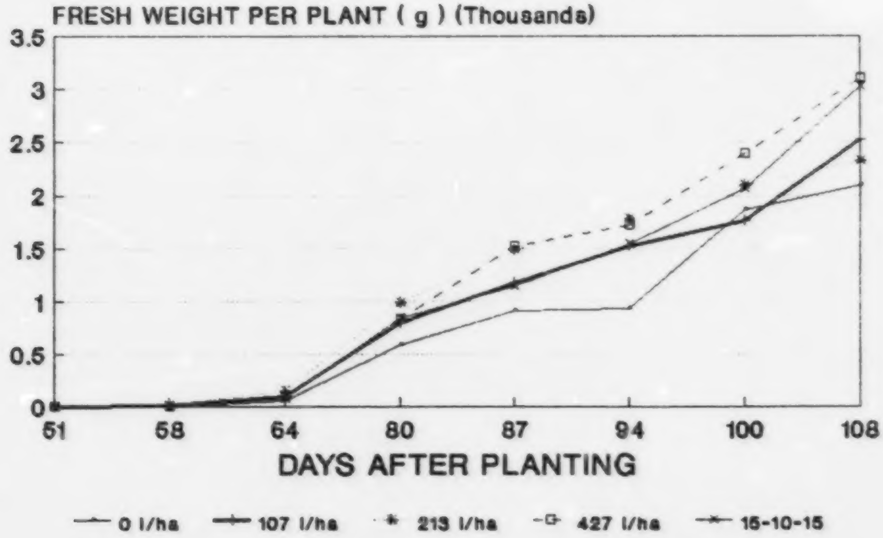


FIG. 15 TUBER GROWTH RATE FOR SHEPODY WITH DIFFERENT FERTILIZER TREATMENTS



Shepody

Both the granular (15-10-15) fertilizer and the 427 l/ha liquid acid fertilizer treatments had the highest tuber growth rates, followed by the 213 l/ha, the 107 l/ha and the 0 l/ha liquid acid fertilizer treatments.

Yield and Quality

The data on yield and specific gravity are presented in Table 3.

Table 3. Effect of five fertilizer treatments on yield and quality of two potato varieties

	Yield (T/ha)						
	Smalls	**Medium**	**Large**	**Off Type**	**Marketable**	**Total**	**Specific Gravity**
1. Fertilizer Treatment							
0 l/ha	4.09^{b}	15.52	2.97	0.14^{b}	18.35	22.58	1.0856
107 l/ha	5.27^{a}	16.32	3.24	0.32^{ab}	19.24	24.83	1.0849
213 l/ha	4.99^{ab}	16.13	3.07	0.57^{a}	18.63	24.19	1.0849
427 l/ha	5.59^{a}	16.03	3.40	0.37^{ab}	19.06	25.00	1.0848
10-15-10	5.21^{a}	18.48	3.01	0.28^{b}	21.24	26.73	1.0856
2. Russet Norkotah	7.52^{a}	13.91^{b}	0.44^{b}	0.22^{b}	14.14^{b}	21.88^{b}	1.0849
Shepody	2.53^{b}	19.09^{a}	5.83^{a}	0.45^{a}	24.47^{a}	27.46^{a}	1.0854
3. Fertilizer Treatment x Variety							
0 l/ha x Russet Norkotah	5.78^{b}	12.13^{c}	0.25	0.00	12.38^{c}	18.16^{c}	1.0853
0 l/ha x Shepody	2.38^{c}	18.87^{a}	5.39	0.29	24.27^{a}	26.93^{a}	1.0860
107 l/ha x Russet Norkotah	8.08^{a}	13.27^{c}	0.15	0.19	13.42^{c}	21.68^{b}	1.0848
107 l/ha x Shepody	2.45^{c}	19.32^{a}	5.68	0.46	25.00^{a}	27.91^{a}	1.0850
213 l/ha x Russet Norkotah	7.70^{a}	13.42^{c}	0.16	0.40	13.58^{c}	21.69^{bc}	1.0850
213 l/ha x Shepody	2.26^{c}	18.79^{a}	4.83	0.74	23.62^{a}	26.62^{a}	1.0848
427 l/ha x Russet Norkotah	8.57^{a}	13.97^{bc}	.00	0.17	13.97^{c}	22.72^{b}	1.0848
427 l/ha x Shepody	2.59^{c}	18.04^{a}	6.05	0.56	24.09^{a}	27.24^{a}	1.0848
899 kg/ha 15-10-15 x Russet Norkotah	7.43^{a}	16.63^{b}	0.60	0.35	17.23^{b}	25.01^{ab}	1.0850
899 kg/ha 15-10-15 x Shepody	2.98^{c}	20.26^{a}	4.92	0.20	25.18^{a}	28.37^{a}	1.0863

Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other.

When both varieties are combined, the fertilizer treatments had no significant effect on marketable and total yields. The 213 l/ha liquid acid fertilizer treatment produced significantly more off type tubers than the 0 l/ha liquid acid fertilizer and the granular (15-10-15) fertilizer treatments. The 0 l/ha liquid acid fertilizer treatment produced the least yield of smalls. There was no significant effect on specific gravity.

When all the fertilizer treatments are combined, Shepody produced better marketable (73% more) and total (26% more) than Russet Norkotah. Shepody had also lower yields in the small category, but had higher yields in the medium size, large size and off type than Russet Norkotah. No significant difference in specific gravity between the two varieties was observed.

Fertilizer x variety interactions were detected for the total, marketable, medium size and smalls yield categories. Although no significant difference in total yield was found for Shepody, total yield generally increased with the increased of the liquid acid fertilizer rates for Russet Norkotah with no significant difference between the 107 l/ha, the 213 l/ha and the 427 l/ha liquid acid fertilizer and the granular (15-10-15) fertilizer treatments. There was, however, a tendency for higher total yield with the granular (15-10-15) fertilizer treatment.

Similar results were obtained with marketable yield for Shepody. However, in the case of Russet Norkotah, although there was no significant difference between the 0 l/ha, 107 l/ha, 213 l/ha and 427 l/ha liquid acid fertilizer treatments, the granular (15-10-15) fertilizer treatment gave the best marketable yield.

The differential varietal response to fertilizer treatments may be explained by the fact that Shepody, a well adapted variety under New Brunswick's growing conditions with a medium to large root system, is capable of extracting phosphorus in a soil with very high levels of P_2O_5 with no addition of phosphorus fertilizer.

On the other hand, Russet Norkotah, a not so well adapted variety to our growing conditions, with a small root system, is not as capable as Shepody to extract phosphorus from the soil. The obtained response to the application of higher phosphorus rate confirms this. However, the higher marketable yield obtained from the granular (15-10-15) fertilizer treatment cannot be explained solely on the quantity of applied phosphorus alone.

The granular (15-10-15) fertilizer treatment brought 89.9 kg/ha of P_2O_5 compared to 111.0 kg/ha of P_2O_5 for the highest rate of liquid acid fertilizer treatment. Either the phosphorus source in the liquid acid fertilizer is not available to the plant or the higher rate produce a phytotoxic effect, or the broadcast of both nitrogen and potash fertilizer are less effective for a small root system or a combination of all of the above can be brought forth to explain

Table 4. Effect of different fertilizer treatments on glucose content, sucrose content and french fry color of Shepody

TREATMENTS	GLUCOSE CONTENT mg/g	SUCROSE CONTENT mg/g	FRENCH FRY AGRON
0 1/ha	0.71	2.23	97.5
107 1/ha	0.70	2.43	97.2
213 1/ha	0.59	2.43	99.6
427 1/ha	0.76	2.35	98.3
15-10-15	0.63	2.23	97.9

this difference. Whatever the case, the granular fertilizer treatment with the analysis, rate and method of application as recommended by the New Brunswick Department of Agriculture and being commonly used by producers in this province out performed the liquid acid fertilizer program as recommended by Stoller Canada Chemical Company Ltd. by 6% (not statistically significant) for Shepody and by 21% (statistically significant) for Russet Norkotah for saleable crop.

Sugar contents and fry colour

Table 4 shows the data for the effect of various fertilizer treatments on glucose content, sucrose content and french fry colour for Shepody. None of the treatments had any effect upon those parameters.

CONCLUSION

The findings of this one year study failed to prove the superiority of the liquid acid fertilizer program as far as marketable yield and quality is concerned.

In fact, reduced marketable yield, 6% (not statistically significant) for Shepody and 21% (statistically significant) for Russet Norkotah, a significantly reduced plant stand at the highest rate of the liquid acid fertilizer treatment for Russet Norkotah and a smaller plant development were associated with the liquid acid fertilizer program.

However, the earlier plant emergence observed with the liquid acid fertilizer program could be investigated further as a mean to promote earlier emergence.

In light of these findings, and based on one year study only, it is difficult to recommend the use of the liquid acid fertilizer program as evaluated in New Brunswick for potato production.

ACKNOWLEDGEMENT

The author respectfully acknowledges the efforts of Enoil Cote, the farmer collaborator during the period the work was undertaken and of Lise Desjardins and Edgar Lavoie for their valuable assistance in carrying out the work.

THE ELECTRONIC POTATO VISITS PACKERS

Ghislain J. Pelletier

ABSTRACT

An electronic potato purchased from the Scottish Centre of Agricultural Engineering in Scotland was used in several potato fresh packing operation in New Brunswick. This device contains electronics that identifies the impacts that potatoes sustain as they travel over handling equipment. There was some degree of variation in the readings of individual drops as the instrument interacted with potatoes and various portion of the grading line. The electronic potato was very useful for a quick indication for potential bruise areas in the handling system.

LA POMME DE TERRE ÉLECTRONIQUE REND VISITE AUX PAQUETEURS

RÉSUME

Une pomme de terre électronique achetée du Centre de génie agricole de l'Institut Écossais a été utilisée dans quelques opérations d'empaquetage des pommes de terre du Nouveau-Brunswick. Cet outil contient une instrumentation électronique capable d'identifier la magnitude des chocs que reçoivent les pommes de terre lors de leur manutention. On a obtenu une certaine variation dans les lecteurs pour une même chute probablement due à l'interaction entre la pomme de terre électronique, les pommes de terre et les diverses composantes de la ligne de manutention. La pomme de terre électronique a été très utile pour rapidement déceler des endroits avec un potentiel de blessures aux pommes de terre sur une chaîne de classage.

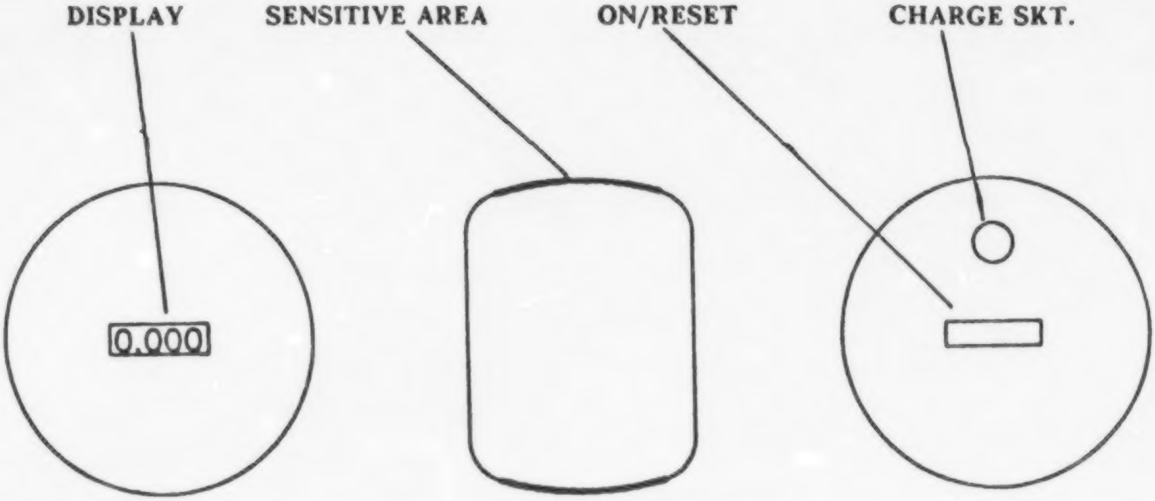
INTRODUCTION

Two electronic potatoes were purchased by the New Brunswick Department of Agriculture in 1989 from the Scottish Centre of Agricultural Engineering in Scotland. Funding was obtained from the 1986-1989 Agri-Food Agreement.

This project was initiated to provide potato extension staff with a tool to identify the areas where potatoes sustain impacts which cause bruising during harvest, handling into storage, grading and packing so that correction measures could be undertaken to reduce the amount of bruising.

The electronic potato is a device that identifies the impact that potatoes sustain as they travel over handling equipment. The impacts are calibrated electronically on a 0 - 7 scale. Reading of 4 usually indicates damage is occurring and readings higher than 4 are a definite indication of damage. This instrument also shows the time elapsed, in seconds, from the time it is switched on, or reset. Thus, it is possible to identify the exact area on the handling system where the highest reading occurs. This device is disk shaped and weighs about 280 g (Figure 1).

FIGURE 1. Shematic representation of the electronic potato



MATERIALS AND METHODS

The electronic potato was used in several fresh packing operation in New Brunswick. The device was put onto the grading line prior to various point of transfer with the flow of potatoes. After each drop, the device was retrieved from the grading line and the reading recorded. This was repeated six times. Information of the variety and tuber temperature were also recorded along with the height and the type of the individual drops and the type of surface onto which the potatoes were falling.

RESULTS

For the purpose of simplicity, the findings of only two of the packing operations are reported in Tables 1 and 2.

Generally, the drops were excessive if we used the recommended maximum drop of 15 cm as a bench mark. There was some degree of variation in the electronic potato readings for individual drops as

Table 1. Summary of results for packing line #1

Packing line 1 (6 tests)
Variety: Superior
Tuber Temperature: 4.4^{0}C

Drop location	**Drop height (cm)**	**Vertical/ Slopping**	**Surface**	**Electronic Potato Readings**	
				Avg.	**Max.**
Hopper to Brusher	30.5	Vertical	Rubber rollers	0.7	1.0
Brusher to Washer	53.3	Slopping	Steel and rubber	0.5	1.0
Washer to Elevator	60.0	Slopping	Rubber flapping	1.3	3.0
Elevation to 1st Sizer	30.5	Vertical	Rubber rollers	0.7	1.0
Sizer to Grading Table	15.2	Slopping	Steel rollers	0.8	2.0
Grading Table to 2nd Sizer	25.4	Vertical	Rubber rollers	- *	-
Sizer to Conveyor	35.6	Vertical	Steel	0.5	2.0
Conveyor to Bagger	12.7	Vertical	Potatoes	0.2	1.0

* - Indicates measurements not taken

Table 2. Summary of results for packing line #2

Variety: Superior
Tuber Temperature: 4.4^{0}C

Drop location	**Drop height (cm)**	**Vertical/ Slopping**	**Surface**	**Electronic Potato Readings Avg.**	**Max.**
Hopper to Elevator	35.6	Vertical	Steel rods	0.5	1.0
Elevator to Chain Sizer	33.0	Vertical	Steel chain	0	0
Chain Sizer to Grading Table	11.4	Vertical	Steel rollers	0.5	1.0
Grading Table to Elevator	34.3	Vertical	Rubber padding	0.8	1.0
Elevator to Washer Sizer	44.5	Slopping	Thin rubber padding on steel	3.0	5.0
Washer to Bagger	50.8	Slopping	Steel/ potatoes	0.5	1.0

the instrument interacted with potatoes and various portions of the grading line. There also seemed to be an interaction between the drop height and the surface onto which the potatoes were falling. The higher value were associated with surfaces like steel rollers and steel surfaces. Readings of 3 and more were found in both grading lines. As those values represent potential bruise areas, recommendations on reduction of the impact by a reduction of the drop height, adding padding or both were made to the packers.

CONCLUSION

The electronic potato was a very useful device for a quick indication of points for potential bruise damage in handling equipment. Quick detecion means quick adjustments and correcting, which translates immediately into more profits for packing line operators.

The variation in impact levels recorded are sufficiently large to require a large number of repetitions (> 5 or 6) on each piece of equipment before arriving at definitive recommendations for equipment modification.

The impact level versus the actual potato damage level for different varieties and different temperatures are needed in order to adequately use the findings from the electronic potato.

It is suggested that in the future, additional tests on commercial packing lines with the electronic potatoes be correlated with the actual potato damage levels as evaluated by the catechol testing procedure. This will enable the establishment of a quick reference for potential bruise areas for different temperatures and varieties.

EVALUATION OF THE USE OF GREEN-SPROUTING AND FLOATING ROW COVERS WITH SEVERAL POTATO VARIETIES GROWN FOR THE EARLY FRESH MARKET

Ghislain J. Pelletier

ABSTRACT

The utilization of two types of floating row covers a polyprolene-polyamid (Agronet) and a pre-perforated (800 - 1 cm holes/m^2) transparent polyethylene in combination with green-sprouting as a mean to advance production of early new potatoes was investigated in New Brunswick in 1990.

The experimental design used was a split-split plot design with the following main treatments: a) cold seed; b) green-sprouted seed (GS); c) GS + Agronet and d) GS + polyethylene. The first split consisted of the following 4 varieties: Chaleur, Belmont, Superior and Jemseg. Two harvest dates 69 and 76 days after planting (DAP) constituted the second split.

Depending on the variety, the green-sprouted seed treatment reached 50% emergence 2 to 5 days earlier than the cold seed treatment. With the addition of floating row covers, again depending on the variety and the cover type, 50% emergence was reached 5 to 7 days earlier than uncovered plots.

Both types of floating covers gave similar yield and significantly higher than uncovered plots at both harvest dates. Superior and Jemseg produced more marketable yield than either Belmont or Chaleur. Of all varieties, Chaleur gave the lowest marketable yield.

At the first harvest date, only Superior and Jemseg green-sprouted and with either type of floating row covers gave positive net returns. For the second harvest date, the highest net returns were obtained with both Superior ($3792/ha) and Jemseg ($3636/ha) green-sprouted and with the polyethylene floating cover. Only Superior gave a positive net return in the cold seed treatment. Chaleur failed to give any positive net return whatever the treatment combinations.

RÉSUMÉ

L'utilisation de deux types de couverture flottante, un polyprolen-polyamid (Agronet) et un polyethylène transparent pré-perforé (800 trous de 1 cm de diamètre/m^2) avec la pré-germination des plants de semence dans le but d'avancer la production de pommes de terre de primeurs du Nouveau-Brunswick a été étudiée en 1990.

Les traitements a) semence froide; b) semence pré-germée (PG); c) PG + Agronet et d) PG + polyethylène ont été assignés aux 4 variétés de pommes de terre suivantes: Chaleur, Belmont, Superior et Jemseg. Les deux dates de récolte 69 et 76 jours après la plantation (JAP) ont constitué le sous traitement.

Selon la variété, les plants pré-germés ont atteint le stade 50% émergence de 2 à 5 jours plus tôt que les plants non pré-germés. L'utilisation de couverture flottante a permis, selon la variété et le type de couverture, d'atteindre le stade 50% émergence de 5 à 7 jours plus tôt que les parcelles sans couverture flottante mais avec plants pré-germés.

Les deux types de couverture flottante ont permis d'obtenir des rendements semblables, mais significativement supérieurs aux parcelles sans couverture flottante et ce, pour les deux dates de récolte. Les variétés Superior et Jemseg ont donné plus de rendements vendables que Belmont et Chaleur. De toutes les variétés, c'est Chaleur qui a produit le moins de rendement vendable.

À la première date de récolte, seule l'utilisation deux deux types de couverture flottante a permis de donner un revenu net positif pour les variétés Superior et Jemseg dont les plants ont été pré-germés.

À la deuxième date de récolte, les plus hauts revenus nets ont été obtenus avec l'utilisation de la couverture flottante de type polyéthylène avec Superior (3792 \$/ha) et Jemseg (3636 \$/ha) dont les plants ont été pré-germés. Seule la variété Superior a donné un revenu net positif dans le traitement de semence froide. Aucun des traitements n'a réussi a donner de revenu net positif pour la variété Chaleur.

INTRODUCTION

Advancing the harvest date of early new potatoes is gaining interest among potato growers in New Brunswick. It enables the potato growers to increase their share of the market and to take advantage of better prices usually received for new potatoes early in summer (Table 1). For the consumers, it provides them with a locally grown product with all the advantages associated with its freshness.

Green-sprouting was introduced in the early 80's in New Brunswick. With the financial assistance of the ASA-II Technology Acceleration program, some 12 growers from all parts of the province have adopted green-sprouting of early maturing varieties as a common practice. Some 50 to 70 hectares of potatoes planted in spring of each year are now being green-sprouted.

In the last couple of years, the utilization of floating row covers in conjunction with green-sprouting has been investigated as a mean to further advance the production of early potatoes. As the same implies, floating row covers are layed loosely over the planted rows immediately after planting and the application of a soil residual herbicide. Those floating covers will warm the soil sooner than uncovered plots and thus stimulating the growth and development of potato plants. They also provide a favourable micro-climate and wind shelter for the plants growing underneath. The cover is lifted up by the plant as they grow.

Two different materials have been investigated in 1988 as row covers for Jemseg potatoes: (1) A pre-perforated clear polyethylene (300 - 1 cm diameter holes per square meter) and (2) Spunbonded polyprolene-polyamid (Agronet). The polyethylene is a cheaper and stronger floating cover than the Agronet. Both floating covers significantly increased marketable yield over the control. However, the polyethylene material, under wind conditions, damaged the potato plants by its flapping effect.

The objective of this study was to compare a high perforation (800-1 cm holes per m^2) to the Agronet and to evaluate the response of several early potato varieties to the use of floating row covers.

Table 1. *Minimum prices of early N.B. potatoes as suggested by the N.B. Potato Agency for the period 1983 to 1990.*

	Suggested prices[1] ($/T)							
WEEK	**1983/84**	**1985[2]**	**1986**	**1987**	**1988**	**1989**	**1990**	**1983-90**
July 6	308	-	440	462	299	990	770	510
July 15	308	-	440	462	299	869	605	471
July 22	308	-	347	374	299	825	407	409
July 29	333	-	347	374	299	660	407	394
August 5	240	-	347	341	264	473	264	310
August 12	200	-	253	297	264	462	264	277
August 19	-	-	227	220	198	462	264	275
AVERAGE	**284**	-	**343**	**361**	**275**	**678**	**426**	

[1] Suggested whoesale prices for 4.54 kg bags

[2] In 1985, due to extremely low prices, no price suggestion was made

METHODS AND MATERIALS

Two different floating row cover materials were investigated: a pre-perforated clear polyethylene (800-1 cm holes/m^2), and a spunbonded polyprolene-polyamid (Agronet). The cost per hectare of the former was $2650 per hectare and $3862 per hectare for the latter in the spring of 1990.

The experimental design used was a split-split plot design with the following main treatments: a) Cold seed; b) Green sprouted seed; c) Green sprouted seed with Agronet and d) Green sprouted seed with polyethylene. The first split consisted of four varieties: 1) Chaleur, 2) Belmont, 3) Superior and 4) Jemseg. Two harvest dates 69 and 76 days after planting (DAP) constituted the second split.

In order to make the comparison between varieties valid, Elite-1 seed for all four varieties were used and they were obtained from the N.B. Bon Accord Seed Farm. Thus all seed was grown and stored under the same conditions. All green-sprouted treatment had the seed sprouted the following way: seed was put in chitting trays and held at 18^0 C in dark for 8 days in order to break dormancy. They were than exposed to a combination of sunlight and artificial light for the duration of the sprouting period which lasted for 22 days. Holding temperatures during the green-sprouting period varied between 8 and 14^0 C. The cold seed was kept at 4-6^0 C until planting time.

Seed was cut in half to obtain 55-60 g sets just before planting.

The plots were established on a gravely sandy loam which was cropped in spring cereal the previous year. Ninety-one (91) cm width rows were opened and 15-15-15 at 900 kg/ha was applied with a two-row planter with the covering disks removed. Seed pieces were hand planted at a precise 22.9 cm in-row spacing on May 2, 1990. Due to the rarity of seed, both Chaleur and Belmont varieties had 2 x 24 hills row plots while Jemseg and Superior had 2 x 36 hills row plots. One row per variety was harvested per harvest date. Three plants of Caribe were used to separate varieties and to act as border plants at the end of rows. Jemseg border rows were used. Main plots thus consisted of 6 rows in width (two varieties with two rows each with border rows) measuring 15.8 m in length. Seed pieces were covered with a 2-row cultivator mounted on a tractor tool bar. On average, seed pieces were covered with 7 cm of soil.

Patoran (400 g/l) was applied at a rate of 5 l/ha the following morning for weed control. Floating row covers were than installed.

Floating covers were removed on June 18th, 1990 (47 DAP). Hilling operation was carried out a few days after.

Emergence and flowering counts were taken periodically and the height of the plants was measured at the floating cover removal time to assess the plants development and growth under various treatments.

Single row plots of each variety were harvested at 69 and 76 DAP (July 10 and July 17). Tubers were hand graded and weighed in the following categories: smalls (less than 47.6 mm in diameter), medium size (between 47.6 mm and 88.9 mm in diameter), large (over 88.9 mm in diameter) and grade defects (to Canada No. 1 standards).

Other observations were made throughout the growing season and are reported herein.

RESULTS

General growth

The month of May in 1990 was cooler than normal with 92% of normal growing degree days and 53% of 1989 growing degree days. As a result, emergence was slower than usual. However, June, slightly warmer than normal, brought the accumulated growing degree days a little bit higher than normal, but still cooler then the previous year. This trend also kept for the first part of July.

Precipitation, although sufficient in quantity, was not well distributed. The first two weeks of June and July were fairly dry which resulted in slower growth of the potato plants.

Some colorado potato beetle and flea beatle damages were evident in the uncovered plots. Very few damages were observed in the plots under the pre-perforated polyethylene and almost no damage was observed under Agronet.

Plant emergence

Emergence curve for the varieties evaluated are presented in Figures 1 to 4. The numbers of DAP to 50% emergence are presented in Table 2 along with the relative gain over the cold seed and the green-sprouted seed treatments.

For the cold seed treatment, Superior was the first variety to emerge followed by Belmont, Chaleur and Jemseg. With the green sprouted treatment both Jemseg and Superior were the first to emerge followed by Belmont and Chaleur. With the utilization of Agronet in addition to green-sprouting, Superior was the first variety to emerge followed by Jemseg, Belmont and Chaleur. Superior was the first variety to come through under the polyethylene with the green-sprouted treatment followed by Belmont, Jemseg and Chaleur.

Jemseg was the best variety to respond to green-sprouting with a gain of 5.5 days over the cold seed treatment. It was followed by Belmont (3.5 days), Chaleur (3.0 days) and Superior (2.0 days).

Superior had the greatest response to the use of floating covers (6 and 7 days gain over green-sprouted for Agronet and polyethylene respectively) followed by Jemseg (3.5 and 5.0 days), Belmont (2.0 and 5.5 days) and Chaleur (1.5 and 2.0 days).

Flowering

Flowering curves are presented in Figures 5 to 8. For Superior and Jemseg, all green-sprouted treatments (with or without floating covers) had 100% of its plants bearing at least one blossom at the last harvest date. However, only Jemseg had close to 100% of its plants in blossom for the cold seed treatment. Belmont and Chaleur had only those plants under floating covers with 100% blossom.

Plant height at floating cover removal

Plant height at floating cover removal (47 DAP) are recorded in Table 3. Although there is a slight increase in the height of the plants from the green-sprouted treatment over the cold treatment, the most important difference is with the use of floating covers which more than doubled the height of the plants when compared to the cold treatment. Generally, the polyethylene floating cover gave slightly higher plants than the Agronet type.

FIG. 1 EFFECT OF GREEN-SPROUTING AND THE USE OF FLOATING ROW COVERS ON THE EMERGENCE OF BELMONT POTATO VARIETY.

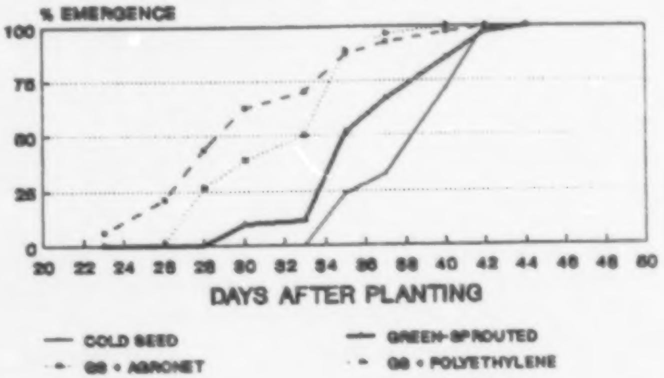


FIG. 2 EFFECT OF GREEN-SPROUTING AND THE USE OF FLOATING ROW COVERS ON THE EMERGENCE OF CHALEUR POTATO VARIETY.

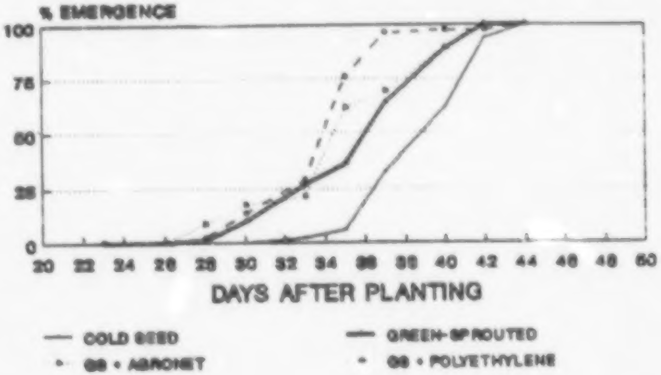


FIG. 3 EFFECT OF GREEN-SPROUTING AND THE USE OF FLOATING ROW COVERS ON THE EMERGENCE OF SUPERIOR POTATO VARIETY.

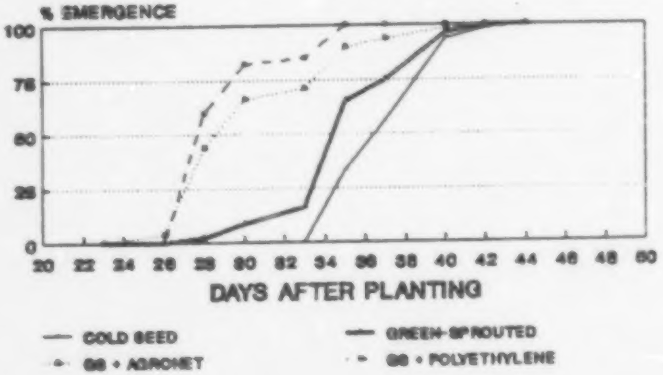


FIG. 4 EFFECT OF GREEN-SPROUTING AND THE USE OF FLOATING ROW COVERS ON THE EMERGENCE OF JEMSEG POTATO VARIETY.

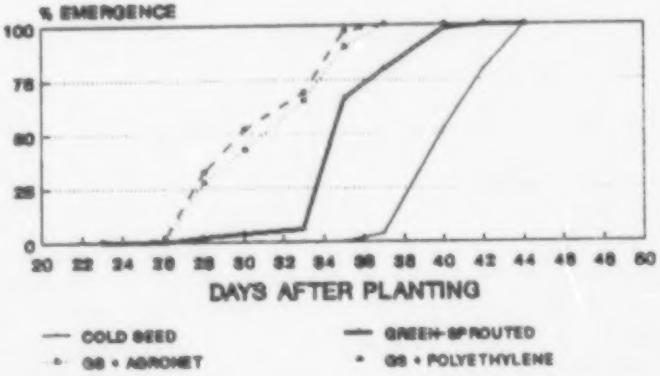


FIG. 5 EFFECT OF GREEN-SPROUTING AND THE USE OF FLOATING ROW COVERS ON THE FLOWERING OF BELMONT POTATO VARIETY.

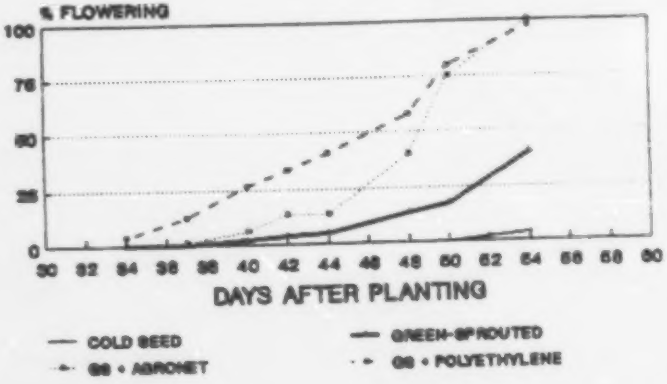


FIG. 6 EFFECT OF GREEN-SPROUTING AND THE USE OF FLOATING ROW COVERS ON THE FLOWERING OF CHALEUR POTATO VARIETY.

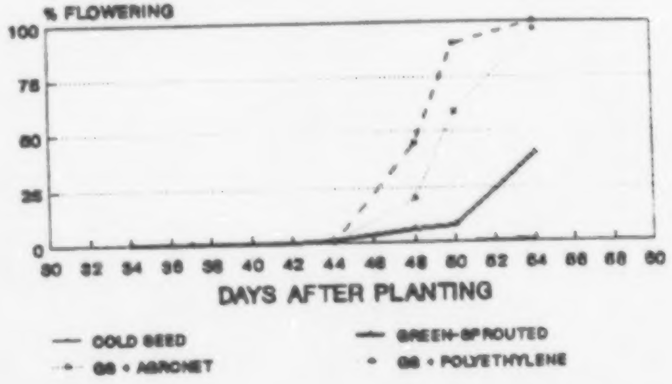


FIG. 7 EFFECT OF GREEN-SPROUTING AND THE USE OF FLOATING ROW COVERS ON THE FLOWERING OF SUPERIOR POTATO VARIETY.

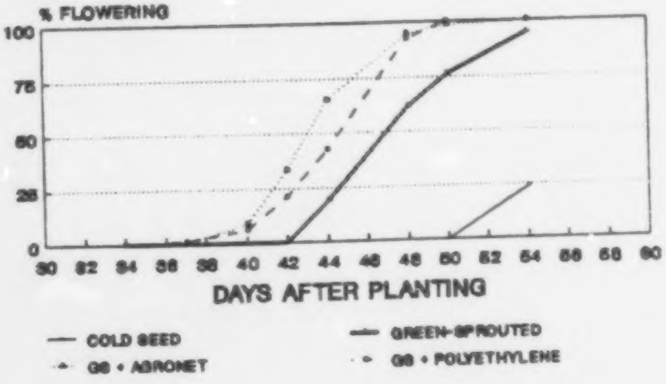


FIG. 8 EFFECT OF GREEN-SPROUTING AND THE USE OF FLOATING ROW COVERS ON THE FLOWERING OF JEMSEG POTATO VARIETY.

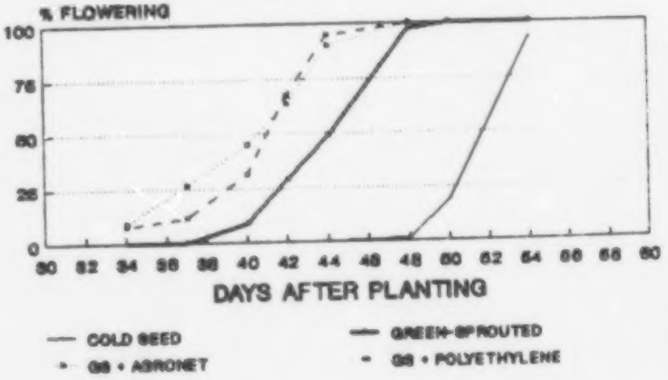


Table 2. *Effect of green-sprouting and the use of floating row covers on the emergence of several potato varieties.*

VARIETY	TREATMENT	DAP (1) 50% EMERGENCE	GAIN OVER	
			COLD SEED	GREEN-SPROUTED
JEMSEG	Cold Seed	39.5	0	-
	Green-Sprouted	34.5	5.0	0
	GS[2]-Agronet	31.5	8.0	3.0
	GS-Polyethylene	29.5	10.0	5.0
BELMONT	Cold Seed	38.5	0	-
	Green-Sprouted	35.0	3.5	0
	GS-Agronet	33.0	5.5	2.0
	GS-Polyethylene	29.0	9.5	6.0
CHALEUR	Cold Seed	39.0	0	-
	Green-Sprouted	36.0	3.0	0
	GS-Agronet	34.5	4.5	1.5
	GS-Polyethylene	34.0	5.0	2.0
SUPERIOR	Cold Seed	36.5	0	-
	Green-Sprouted	34.0	2.5	0
	GS-Agrpmet	29.0	7.5	5.0
	GS-Polyethylene	27.0	9.5	7.0

(1) DAP: Days after planting

(2) GS: Green-Sprouted

Table 3. *Potato plant height at floating cover removal (48 days after planting)*

TREATMENT	(CM)			
	Belmont	Chaleur	Superior	Jemseg
Cold Seed	10.2	10.4	9.7	8.1
Pre-Sprouted	11.7	14.0	14.2	10.9
Pre-Sprouted and Agronet	26.7	22.6	27.9	22.4
Pre-Sprouted and polyethylene	29.0	23.6	30.7	23.1

Yield

First Harvest

Yield data for the first harvest (69 DAP) is presented in Table 4. Yields were generally low at the first harvest with the highest marketable yield at 12.2T/ha. Both floating cover treatments increased significantly the 48 mm to 89 mm, total and marketable yields over the uncovered treatments. There was no significant difference between the two types of floating cover. The response to floating covers represented a three fold increase and a 5.3T/ha increase over the green-sprouted treatment. The cold seed treatment had the lowest yield with 0.13T/ha of marketable crop.

Both Superior and Jemseg varieties gave significantly higher 48 mm to 89 mm and marketable yields than either Chaleur or Belmont. Belmont gave significantly higher yield in the 48 mm to 89 mm, marketable and total categories than Chaleur. Jemseg yielded significantly more in the total category than Superior but this was also true for both grade defect and small categories.

Seed and floating cover treatment x variety interactions were detected for the less than 48 mm, 48 mm to 89 mm, total and marketable yields. No significant differences in marketable and in the 48 mm to 89 mm range, among the varieties for cold seed treatments were found. However, Jemseg, Superior and Belmont gave significantly higher marketable and 48 mm to 89 mm range yields than Chaleur for the green-sprouted with plastic treatment. The marketable yields were significantly higher for the Jemseg and Superior varieties than both Belmont and Chaleur for the green-sprouted with Agronet treatment. Belmont also gave significantly higher marketable yield than Chaleur. For the Jemseg variety, the use of Agronet type of floating cover gave significantly higher marketable yield than the polyethylene type, although there was no significant difference for the total yield. Both types of floating cover gave similar marketable yield for Superior, Belmont and Chaleur.

Second Harvest

Yield data for the second harvest (76 DAP) is presented in Table 5. By the second harvest, marketable yield increased substantially with the highest marketable yield at 17.60 T/ha.

Both floating row covers significantly increased the 48 mm to 89 mm, total and marketable yields over the uncovered plots. There was no significant difference between the two type of floating covers. The response to floating row cover represented a 168%

Table 4. *Effect of green-sprouting and the use of floating covers on potato yield at the first harvest (69 days after planting)*

SEED TREATMENT AND FLOATING COVER	VARIETY	YIELD (T/HA)					
		Small(4)	**Medium(5)**	**Large(6)**	**Gr.Defects**	**Total**	**Marketable**
Cold Seed	Avg(2)	3.09 BC(3)	0.13 C	0.00	0.2 B	3.23 C	0.13 C
GS(1)	Avg	3.49 A	2.61 B	0.00	0.03 A	6.13 B	2.61 B
GS + Agronet	Avg	2.97 C	8.07 A	0.00	0.09 A	11.23 A	8.14A
GS + Polyethylene	Avg	3.46 AB	8.17 A	0.00	0.07 AB	11.41 A	7.88 A
	Significant	Yes	Yes	No	No	Yes	Yes
Avg	Chaleur	3.72 A	1.41 C	0.00	0.02 BC	5.15 D	1.41 C
Avg	Belmont	2.97 B	4.56 B	0.00	0.00 C	7.53 C	4.56 B
Avg	Superior	2.60 B	6.16 A	0.00	0.06 AB	8.82 B	6.16 A
Avg	Jemseg	3.73 A	6.10 A	0.00	0.12 A	10.50 A	6.66 A
	Significant	Yes	Yes	No	Yes	Yes	Yes
Cold Seed	Chaleur	2.52 DE	0.00 G	0.00	0.00 D	2.52 HI	0.00 H
	Belmont	1.98 E	0.08 G	0.00	0.00 D	2.06 I	0.08 CD
	Superior	3.26 CD	0.21 G	0.00	0.01 D	3.48 GHI	0.21 H
	Jemseg	4.60 AB	0.21 G	0.00	0.06 BCD	4.87 FG	0.21 H
GS	Chaleur	3.48 BCD	0.42 FG	0.00	0.00 D	3.90 GH	0.42 GH
	Belmont	3.09 CDE	1.88 EFG	0.00	0.00 D	4.97 FG	1.88 FGH
	Superior	2.51 DE	3.81 DE	0.00	0.00 D	6.31 EF	3.81 EF
	Jemseg	4.91 A	4.31 D	0.00	0.11 ABCD	9.33 D	4.31 E
GS + Agronet	Chaleur	4.14 ABC	2.78 DE	0.00	0.04 CD	6.95 E	2.78 EF
	Belmont	3.44 BCD	7.59 C	0.00	0.00 D	11.03 CD	7.59 D
	Superior	2.04 E	10.12 AB	0.00	0.18 A	12.35 BC	10.12 ABC
	Jemseg	2.27 DE	12.19 A	0.00	0.14 ABC	14.60 A	12.19 A
GS + Polyethylene	Chaleur	4.74 A	2.43 DEF	0.00	0.05 BCD	7.22 E	2.43 EFG
	Belmont	3.38 CD	8.68 BC	0.00	0.00 D	12.05 BC	8.68 BCD
	Superior	2.58 DE	10.51 AB	0.00	0.06 BCD	13.15 AB	10.51 AB
	Jemseg	3.12 CDE	9.92 B	0.00	0.15 AB	13.20 AB	9.92 BC
	Significant	Yes	Yes	No	No	Yes	Yes

(1) **GS:** Green-Sprouted

(2) **AVG:** Average

(3) Duncan's multiple range test: 0.05 level - means with the same letter are not significantly different from each other.

(4) **Small:** < 48 mm

(5) **Medium:** 45 - 89 mm

(6) **Large:** > 89 mm

Table 5. *Effect of green-sprouting and the use of floating covers on potato yield at the second harvest date (76 days after planting).*

SEED TREATMENT AND FLOATING COVERS	VARIETY	YIELD (T/HA)					
		Small(4)	Medium(5)	Large(6)	Gr.Defects	Total	Marketable
Cold Seed	Avg(2)	5.98 A(3)	3.97 C	0.00	0.08	10.59 C	3.97 C
GS(1)	Avg	4.25 B	8.75 B	0.00	0.10	13.11 B	8.75 B
GS+Agronet	Avg	2.66 C	14.33 A	0.04	0.12	17.16 A	14.37 A
GS+Polyethylene	Avg	2.72 C	15.00 A	0.11	0.19	18.02 A	15.11 A
	Significant	Yes	Yes	No	No	Yes	Yes
Avg	Chaleur	4.16 B	7.46 C	0.00	0.00 B	11.62 D	7.46 C
Avg	Belmont	4.88 A	9.72 B	0.06	0.07 B	14.72 C	9.77 B
Avg	Superior	3.00 C	12.64 A	0.07	0.06 B	15.76 B	12.70 A
Avg	Jemseg	3.58 B	12.24 A	0.03	0.36 A	16.77 A	12.27 A
	Significant	Yes	Yes	No	Yes	Yes	Yes
Cold Seed	Chaleur	4.94 CDE	3.78 EF	0.00	0.00	8.72	3.78 FG
	Belmont	7.28 AB	2.79 E	0.00	0.03	10.10	2.79 G
	Superior	6.22 AC	5.04 E	0.00	0.00	11.26	5.04 F
	Jemseg	7.73 A	4.25 EF	0.00	0.29	12.27	4.25 FG
GS	Chaleur	4.78 DE	5.42 E	0.00	0.00	10.21	5.42 F
	Belmont	5.32 CD	8.22 D	0.00	0.15	13.69	8.22 E
	Superior	2.33 HIJ	10.72 C	0.00	0.03	13.13	10.72 D
	Jemseg	4.58 DEF	10.66 C	0.00	0.18	15.41	10.66 D
GS+Agronet	Chaleur	3.27 FGHI	9.78 CD	0.00	0.00	13.05	9.78 DE
	Belmont	3.86 EFG	13.36 B	0.00	0.00	17.22	13.36 C
	Superior	1.37 I	17.28 A	0.17	0.03	18.85	17.46 A
	Jemseg	2.16 IJ	16.89 A	0.00	0.46	19.51	16.89 AB
GS+Polyethylene	Chaleur	3.65 EFGH	10.85 C	0.00	0.00	14.50	10.85 D
	Belmont	3.07 GHI	14.49 B	0.23	0.09	17.88	14.72 BC
	Superior	2.07 IJ	17.50 A	0.10	0.13	19.81	17.60 A
	Jemseg	2.10 IJ	17.17 A	0.11	0.52	19.90	17.27 A
	Significant	Yes	Yes	No	No	No	Yes

(1) **GS:** Green-Sprouted

(2) **AVG:** Average

(3) Duncan's multiple range test: 0.05 level - means with the same letter are not significantly different from each other.

(4) **Small:** < 45 mm

(5) **Medium:** 45 - 89 mm

(6) **Large:** > 89 mm

(6.0 T/ha) increase green-sprouted treatment and a 370 % (10.7 T/ha) increase over the cold seed treatment. The cold seed treatment had the lowest yield with less than 4T/ha of marketable crop.

Both Superior and Jemseg varieties gave significantly higher 48 mm to 89 mm and marketable yields than either Chaleur or Belmont. Belmont gave significantly higher yield in the 48 mm to 89 mm, marketable and total categories than Chaleur. Jemseg yielded significantly more in the total category than Superior, but this was also true for both grade defect and small categories.

Seed and floating cover treatment x variety interactions were detected for the less than 48 mm, 48 mm to 89 mm and marketable yields. Of all varieties in the cold seed treatment, only Superior gave significantly higher marketable yield than Belmont. Both Superior and Jemseg gave significantly higher marketable yield than Belmont and Chaleur in the green-sprouted with no floating cover, green-sprouted with Agronet and green-sprouted with polyethylene treatments. Also, Belmont gave significantly higher marketable yield than Chaleur.

The type of floating cover had no effect on yield of individual potato variety.

ECONOMICAL ASPECT

Net returns for the different varieties and the different seed and floating cover treatments are presented in Table 6. Those net returns are based on average prices received for early potatoes for the period 1983 to 1990 and at estimated costs of production appearing in Table 6.

For the first harvest, only Superior and Jemseg under both types of floating covers gave positive net returns. The rather cool month of May has given a net advantage to the floating cover treatments. Uncovered treatments gave yield somewhat smaller than the previous years for similar planting and harvesting dates.

For the second treatment, only the Superior variety gave a positive return in the cold seed treatment. Only Chaleur failed to give positive return for all of the other treatments. The best net returns were obtained with both Superior and Jemseg under the polyethylene type of floating row cover.

CONCLUSION

The utilization of floating row covers in combination with green sprouting have significantly advance the plant development and significantly increase marketable yields of all four early varieties in the study. Both types of floating covers (Agronet and pre-perforated polyethylene) gave similar results in terms of plant development and yield. With all the treatments combined, Superior and Jemseg produced more marketable yield than either Belmont and Chaleur. Belmont also had a higher marketable yield than Chaleur.

An economical analysis, using the average potato prices received for early potatoes during the period 1983 to 1990 for the corresponding harvest dates revealed that for the first harvest date only green-sprouted seed of Superior and Jemseg with either type of floating row covers gave positive net returns. For the second harvest date, the highest net return were obtained with both Superior and Jemseg under the polyethylene type of floating row cover. Chaleur failed to give any positive net return whatever the treatment combinations. Superior was the only variety to give a positive net return with cold seed and no floating row cover. Treatment combination which gave positive and net returns are as follows:

	VARIETY	HARVEST DATE	GREEN-SPROUTED TREATMENT	TREATMENT	NET RETURN ($/HA)
1.	Superior	Second	Yes	Polyethylene	3792
2.	Jemseg	Second	Yes	Polyethylene	3636
3.	Superior	Second	Yes	Agronet	3118
4.	Jemseg	Second	Yes	Agronet	2849
5.	Belmont	Second	Yes	Polyethylene	2435
6.	Superior	Second	Yes	Uncovered	2085
7.	Jemseg	Second	Yes	Uncovered	2057
8.	Belmont	Second	Yes	Agronet	1187
9.	Jemseg	First	Yes	Agronet	1111
10.	Belmont	Second	Yes	Uncovered	908
11.	Superior	First	Yes	Polyethylene	862
12.	Jemseg	First	Yes	Polyethylene	561
13.	Superior	Second	No	Uncovered	150
14.	Superior	First	Yes	Agronet	55

Table 6. Net return for different potato varieties, seed and floating cover tretments at two harvest dates

SEED AND FLOATING COVER TREATMENT[1]	VARIETY	NET RETURN ($/HA)	
		First harvest (2)	Second harvest(3)
Cold Seed	Chaleur	- 2223	- 443
	Belmont	- 2182	- 909
	Superior	- 2116	+ 150
	Jemseg	- 2116	- 221
Green-Sprouted	Chaleur	- 2750	- 411
	Belmont	- 2005	+ 908
	Superior	- 1021	+2085
	Jemseg	- 766	+2057
Green-sprouted and Agronet	Chaleur	- 3688	- 500
	Belmont	- 1223	+ 1187
	Superior	+ 55	+ 3118
	Jemseg	+ 1111	+ 2849
Green-sprouted and polyethylene	Chaleur	- 3259	- 612
	Belmont	- 71	+ 2435
	Superior	+ 862	+ 3792
	Jemseg	+ 561	+ 3636

Estimated cost of production for various treatments:

Cold Seed: - $2223/ha

Green-Sprouted: $2964/ha

Green-Sprouted+Agronet (2-yr. utilization): $5106

Green-Sprouted + Polyethylene (2-yr. utilization): $4498/ha

[2] **Price:** Second week of July - 1983 to 1990 average $510/T

[3] **Price:** Third week of July - 1983 to 1990 average $471/T

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THE UTILIZATION OF PORTABLE MONITORING EQUIPMENT TO IMPROVE PLANT STAND

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RÉSUMÉ

Des équipements portatifs de control pour évaluer les opérations de tranchage de semence de pomme de terre ont été utilisés par le peronnel du ministère de l'Agriculture du Nouveau-Brunswick. L'objectif premier de ce projet a été donner des outils pour évaluer les opérations de tranchage de semence de pommes de terre de façon à améliorer la levée des plants de pommes de terre dans les champs commerciaux.

Les résultats obtenus de même que les problèmes rencontrés sont discutés.

ABSTRACT

This project involved the evaluating of portable monitoring equipment by a Machinery Technician and two Potato Production Specialists for the purpose of increasing staff efficiency and providing immediate more accurate results for the potato seed cutting operations. The objective was to provide a mechanism for monitoring seed cutting operations to determine effectiveness in improving plant stands in commercial potato fields. Objectives realized, results and associated problems are discussed.

INTRODUCTION

In previous years, Agricultural Engineering and Regional Production staff have gathered data and seed on potato farms, taken these back to regions offices, analyzed the material collected and then gave the results to the grower. By providing portable digital balances/statpac/printer to Extension Specialists, on-farm seed cutting and planting operations can be monitored resulting in improved potato seed cutting and planter field performance. Improving these areas will result in improved spacing, production yield and percentage of marketable tubers.

Extension services for the potato industry are provided by two areas of the N.B. Dept. of Agriculture. The Agricultural Engineering Section currently provides a service of demonstrating to growers how to calibrate picker type potato planters. The Northwestern and Western Regions provide extension services in the potato production area for optimum seed and planting techniques. Scales/statistical printers placed in each of these areas enables each to upgrade services with accurate on-site testing of seed resulting in more growers served.

The objective of this project is to provide a mechanism for monitoring seed cutting and planting operations to determine their effectiveness in improving plant stands in commercial potato fields.

MATERIAL AND METHODS

Three sets of digital balances, statpacs, printers, Electrosonic inverters, and accessories were purchased and distributed to Departmental personnel. A meeting was held with the two potato production specialists, Potato Seed Specialist, Machinery Technician and Machinery Engineer. Standards for testing procedures, desired result limits and ranges, and precautionary disinfecting procedures were set as shown in Appendix 1. Balances were to be used on-site during cutting operations and in the field while evaluating planter performance.

Sixteen field co-efficient of variation tests were conducted throughout the Saint John Valley. Testing was done for farmers requesting assistance on picker type planters. Testing variables included a broad cross-section of areas, planting conditions, potato varieties, intended spacing, methods of cutting seed, models of picker planters, and ground speeds. Firstly, planters are evaluated for repairs and maintenance and then calibrated according to manufacturers specifications. In the field, covering discs were marked and opened on all four rows. Misener (1979) stated that his trials indicated that when discs were removed, seed placement was not altered. Planters were then brought to speed, planted over 100 ft and closed. Four 40 ft rows were selected in an area representative of actual planting speed. The uncovered seed pieces were measured center to center to the nearest 1/2 inch. The seed was collected, bagged and marked. The test site was replanted and covered. Seed was weighed and analyzed per row and on average. Analysis of seed was compared to planter results. Overall results of testing indicate that goals set for planter performance will have to be modified.

RESULTS AND DISCUSSION

Actual use of scales/statpacs/printers in the Agricultural Engineering Section was limited by availability of equipment, tendering progress and a problem incurred with readability. However, for this activity of analyzing seed for planter co-efficient testing, a similar statpac/printer/scales was used in a Regional Office. Actual equipment purchased was tried when received near the end of the season. It was found the "portability" may be limited to growers storages. The Electrosonic invertors purchased can only be used for short term testing due to the fact that they draw 2.3 amps all the time they are plugged in. If inverters are left plugged for extended periods of time, they will drain a 12-volt battery.

A total of 16 planter co-efficient of variation tests were done. This represents 17 seed tests consisting of 65 samples and 2761 pieces of seed. For actual weighing, handling and analysis (mean, standard deviation, numbers of pieces in four categories, total). It averaged 10 sec per piece, 7 min per sample (base on 42 avg) and 28 min. per test site. A sample of a statpac read out and all seed testing results are included in the Appendix 3. The seed analysis data was then calculated to show size groups in percent (by numbers). This was followed by visual observation and rating for seed size and uniformity.

Analysis in table 1 shows that seed C.V. ranged from 23.2 to 46.5. The 23.2 seed C.V. was hand cut by experienced cutters. Planter C.V. ranged for 26.9 to 64.2. However, the 26.9 C.V. was not considered the best test due to other contributing factors. These factors were plant population, intended vs. obtained spacing and acceptable intervals. The best planter test had a C.V. of 46.5.

Computing results also shows a direct trend between planter performance and seed size per row and on average. Statistical analysis of all data was compiled and evaluated. Results are listed in correlation table 2 (by individual rows). Criteria definitions are listed in Appendix 2.

Visual planter field performance showed noticeable problems with non-uniform, oversized seed and extremely small pieces. Small pieces tend to cause doubles, triples and misses. Large pieces can be knocked off when entering the chute area and either fall back in the bowl or fall down the chute, causing a double and/or a miss.

The Northwestern and Western Regional Potato Production Specialists were limited to working with a small number of seed cutting operations. The goal was 30 producers, but it was possible to work with 12 only. The reason for this unfortunate circumstance is due to funding not effective until April 1st, provincial tendering process, and suppliers delivery time. A follow-up report on seed cutting operations will be submitted for the 1991 season.

Additional problems incurred were the amount of current drawn by the Electrosonic inverter, and Digital Balance readability. Mettler model PM 6 balances having a readability of 1 g were purchased. After experimenting by Department of Fisher Scientific staff, it was found that the model PM 6 balances were accurate enough for simple weighing, but not for statistical analysis. When the model PM 6 were connected to the Statpac M and printers, they would not function below 0.8 oz. These balances were returned and substituted with the Model PM6000 having a readability of 0.1 g. The one limitation of the Model PM6000 statpac/Printer is that if data is to be re-evaluated using different variables, it cannot be re-entered through the statpac. Re-evaluation must be done using a computer or re-weighing all samples.

As mentioned previously, Regional Specialists did work with 12 producers this season. Individual weighing by hand and manual calculation methods were utilized. Results indicate it takes 18 seconds per seed piece and an average of 3 hours to complete analysis of a 300 piece test. Using this method, only 44% of growers can be served as compared to using the Balance/statpac/Printer combination. By using the monitoring equipment next year, it is projected that 22 growers can be consulted with utilizing the same time that it took to work with 12.

CONCLUSION

Seed size uniformity have a direct affect on planter performance. The scales/statpac/printer combination enable extension personnel to consult with more potato growers. Information gathered for the 1990 season can be used for technical workshops, a comparison for additional statistical analysis, and data for other interested parties.

Other contributing factors affecting planter performance must be considered. These are planter condition and calibration, ground speed vs. intended spacing, soil preparation, land topography, amount of seed kept in picker bowls, number and configuration of picks, seed variety and seed condition. An improvement on all variables should results in an improved plant stand.

The portable monitoring equipment evaluated for seed does permit on-site immediate results to potato producers. In order to give immediate results on planter performance, portable computers and appropriate software would be required.

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APPENDIX 1

STANDARDS FOR TESTING PROCEDURES, DESIRED RESULT LIMITS AND RANGES, AND PRECAUTIONARY SANITARY PROCEDURES

SEED CUTTING, MONITORING

The following are the procedures for seed cutting monitoring. These constitute a minimum in order to make possible the polling and analysis of information gathered by different individuals. Please note that individuals may want to do more than this minimum.

a) **Mother tuber size distribution**

One sample of mother tuber per sample of seed pieces (3). This mother tuber sample should be taken as close as possible to the time of sampling for the seed pieces. The sample taken should consist of 12 to 15 pounds of potatoes. The suggested size distribution intervals are as follow:

- # of tubers < 3 oz.
- # of tubers between 3 to 6 oz.
- # of tubers between 6 to 9 oz.
- # of tubers between 9 to 12 oz.
- # of tubers > 12 oz.

b) **Seed pieces size and type distribution**

Three samples of 12 to 15 pounds of seed pieces should be taken. The suggested seed size distribution intervals are as follow

- # seed pieces less than 1 oz.
- # seed pieces from 1 to 1.5 oz.
- # seed pieces from 1.5 to 2.5 oz.
- # seed pieces from 2.5 to 3.0 oz.
- # seed pieces over 3 oz.

The type of seed pieces (i.e. # of cuts) can also be assessed if time permits.

c) **Seed pieces size standards**

Parameters	**Target**	**Critical**
Average weight	1.75 to 2 oz.	< 1.4 oz.
% # seed pieces < 1 oz.	< 10%	> 15%
% # seed pieces > 2.5 oz.	< 10%	> 15%
% # seed pieces in acceptable intervals (1.5 - 2.5 oz)	> 65%	< 55%

d) **Sanitary procedures**

In order to eliminate the risk of disease transmission, the following procedures were followed:

- Disinfect footwear, gloves and equipment before entering seed cutting area
- Disinfect scale platform with a solution of 70% alcohol
- Use new disposable plastic bags to line the buckets used to collect samples
- Use serand wrap to cover the scale platform

PLANTER PERFORMANCE EVALUATION

The following are the procedures used for the evaluation of potato planters performance.

a) **Seed pieces placement**

Collect data from the planter # of rows (i.e. 4-row for a 4-row planter). The seed placement should be taken by measuring centre to centre at the closest 1/2 inch.

The length of the rows should be 40 feet. The planting speed can either be measured using a tachometer on the surface of the planter wheel or by timing the travel of the implement for a minimum of 50 feet.

Ideally, the seed measured to determine the seed placement should also be analyzed for the size distribution and CV (one sample per row).

b) **Seed placement standards**

Parameters	**Target**	**Critical**
% CV	45 - 50%	> 55%
% skips	< 5%	> 10%
% doubles	< 5%	> 10%
% in acceptable interval (# or - 3 inches)	60 - 65%	< 55%
Lower limit	< 20%	> 25%
% Plant population	> 85 - 90%	< 80 - 85%

APPENDIX 2

DEFINITION OF CRITERIA

Double = Less or equal to 3 inches

Skip = Greater or equal to 2 x intended spacing

Double Skip = Greater or equal to 3 x intended spacing

Acceptable Interval = Obtained spacing + or -3 inches

Lower Limit = Obtained spacing - 3 inches

Higher Limit = Obtained spacing + 3 inches

TABLE 1

1990 SEED CARACTERISTICS EFFECT ON THE PERFORMANCE ON POTATO PLANTERS SURVEY

	PLANTER PERFORMANCE											SEED CARACTERISTICS								
	TS	IS	OS	PP	PCV	SK	DSK	DL	AI	LL	HL	SW	SCV	A	B	C	D	E	OSZ	OSH
SHEPODY																				
A	3.3	10.5	10.8	97	58.2	7.4	0.6	10.8	33	36.4	30.7	1.77	37.3	12	23.4	51	10.9	2.7	5	6
B	3.6	10.5	10.3	102	46.5	4.3	0	6.9	55.9	22.9	21.3	1.77	23.2	2.6	12.1	69.5	15.3	0.5	10	10
C	4.35	9.9	10.5	94.6	47.5	5.4	0	5.4	48.9	26.9	24.2	2.2	39.1	7.2	13.7	46.7	15.9	16.5	6	7
D	4.35	9.9	11	90.4	47.5	5.4	3.5	9.8	44.5	32.4	23.1	1.61	37.3	12.2	33.9	47.9	3.6	2.4	5	4
E	3.6	11.5	11.1	103.3	58.3	5.2	0.7	8.2	33.6	38.1	28.4	1.87	46.5	16.8	18.4	41.9	14	8.9	5	7
AVG	3.84	10.46	10.74	97.46	54.82	6.66	0.96	8.22	43.18	31.34	25.54	1.844	36.68	10.16	20.3	51.4	11.94	6.2	6.2	6.8
MIN	3.3	9.9	10.3	90.4	46.5	4.3	0	5.4	33.6	22.9	21.3	1.61	23.2	2.6	12.1	41.9	3.6	0.5	5	4
MAX	4.35	11.5	11.1	103.3	63.6	11	3.5	9.8	55.9	38.1	28.4	2.2	46.5	16.8	33.9	69.5	15.9	16.5	10	10
KENNEBEC																				
F	4.1	7.5	7.3	102.8	60.2	6.3	0.4	21.1	51.1	30.4	18.5	1.57	37.6	16.3	30.7	46.2	5.3	1.5	5	5
RUSSET NORKOTAH																				
G	5.0	10.9	11	99.3	64.2	9.1	1.1	14.3	36.6	37.1	26.3	1.77	29.9	6.6	24.9	60.2	6.6	1.7	9	9
NORCHIP																				
H	3.25	9	7.8	115.7	61.9	4.7	0	19.4	46.2	32	21.7	1.26	39.7	32.6	38.3	27.6	1.5	0	4	5
RUSSET BURBANK																				
I	4.1	13.5	13.1	103.3	60.3	6.7	0	15.3	40.7	30	29.3	1.6	36.3	14.6	32	47.4	5.4	0.6	6	6
J	4.1	13.5	12.8	105.5	61.5	4.4	0.6	9.5	25.9	40.5	33.6	1.59	38.4	14.2	33.1	45	5.9	1.8	6	6
K	3.35	15.5	18.1	85.7	26.9	2.8	0	0	51.9	25.5	22.6	1.45	34.5	18	43	36	3	0	6	6
L	3.6	15.5	16.1	96.3	50.5	5	0.8	3.3	43	32.2	24.8	1.94	34.5	7.3	19.4	50.8	16.9	5.6	6	6
M	3.6	15.5	15.6	99.4	47.2	4.9	0	4.1	40.2	32.8	27	1.81	37	9.5	26	47.2	13.4	3.9	7	6
N	3.75	15.9	16.2	98	43.1	1.6	0	3.3	45.1	29.5	25.4	1.84	38.6	4.8	31.7	46	9.5	8	6	7
O	4.0	16.6	16.4	100.5	61.1	5.8	0	10.7	16.5	43.8	39.7	1.8	40	9.4	32	42.2	9.4	7	5	6
P	4.3	16.7	15.1	110.8	54.1	1.6	0.8	7	30.5	35.9	33.6	1.8	41.1	16.8	19.8	44.3	12.2	6.9	5	5
AVG	3.85	15.3	15.4	99.9	50.6	4.1	0.3	6.7	36.7	33.8	29.5	1.7	37.6	11.8	29.6	44.9	9.5	4.2	5.9	6.0
MIN	3.35	13.5	12.8	85.7	26.9	1.6	0	0	16.5	25.5	22.6	1.45	34.5	4.8	19.4	36	3	0	5	5
MAX	4.1	16.7	18.1	110.8	61.5	6.7	0.8	15.3	51.9	43.8	39.7	1.94	41.1	18	43	50.8	16.9	8	7	7

LEGEND:

IS - Intended spacing
OS - Obtained spacing
PP - Plant population
PCU - Planter co-efficient of variation
SK - Skips
DSK - Double skips
DL - Doubles
AI - Acceptable interval
HL - Higher limit

SW - Mean seed Weight
SCW - Seed co-efficient of variation
A - < 1.0 oz.
B - 1.0 to 1.5 oz.
C - 1.5 to 2.5 oz.
D - 2.5 to 3.0 oz.
E - > 3.0 oz.
OSZ - Observation of size
OSH - Observation of shape

TABLE 2

CORRELATION ANALYSIS

	ALL VARIETIES		RUSSET BURBANK		OTHER VARIETIES	
PLANT POPULATION	r	p	r	p	r	p
SEED WEIGHT	-.22	.1	+.10	NS	-.42	.05
SEED CV	+.24	.1	+.48	.01	+.14	NS
< 1 OZ.	+.18	NS	+.20	NS	+.52	.01
1.0 - 1.5	-.11	NS	-.41	.05	+.16	NS
1.5 - 2.5	-.15	NS	+.24	NS	-.36	.05
2.5 - 3.0	-.002	NS	+.14	NS	-.09	NS
73.0	-.09	NS	+.01	NS	-.16	NS
PLANTER CV						
SEED WEIGHT	-.19	NS	+.05	NS	-.47	.01
SEED CV	+.20	NS	+.40	.05	+.17	NS
< 1 OZ.	-.01	NS	-.23	NS	+.30	.1
1.0 - 1.5	+.01	NS	-.23	NS	+.57	.001
1.5 - 2.5	+.06	NS	+.29	NS	-.25	NS
2.5 - 3.0	-.24	.1	-.16	NS	-.35	.05
73.0	-.14	NS	+.12	NS	-.43	.05
SKIPS						
SEED WEIGHT	-.08	NS	-.09	NS	-.08	NS
SEED CV	-.10	NS	-.06	NS	-.08	NS
< 1 OZ.	-.11	NS	-.10	NS	-.14	NS
1.0 - 1.5	+.04	NS	-.03	NS	+.31	.1
1.5 - 2.5	+.16	NS	+.18	NS	+.06	NS
2.5 - 3.0	-.21	.1	-.28	NS	-.17	NS
73.0	-.13	NS	-.01	NS	-.22	NS
DOUBLE SKIPS						
SEED WEIGHT	-.07	NS	+.04	NS	-.13	NS
SEED CV	+.03	NS	+.14	NS	+.02	NS
< 1 OZ.	-.11	NS	-.12	NS	-.12	NS
1.0 - 1.5	+.10	NS	-.03	NS	+.30	.1
1.5 - 2.5	+.12	NS	+.11	NS	+.08	NS
2.5 - 3.0	-.20	NS	-.18	NS	-.21	NS
73.0	-.06	NS	+.28	NS	-.22	NS
DOUBLES						
SEED WEIGHT	-.39	.01	-.19	NS	-.55	.001
SEED CV	+.13	NS	+.27	NS	+.14	NS
< 1 OZ.	+.25	.05	-.02	NS	+.51	.01
1.0 - 1.5	+.08	NS	-.09	NS	+.45	.01
1.5 - 2.5	-.10	NS	+.22	NS	-.38	.05
2.5 - 3.0	-.24	.1	-.25	NS	-.23	NS
73.0	-.27	.05	-.18	NS	-.35	.05
ACCEPTABLE INTERVAL						
SEED WEIGHT	+.01	NS	+.03	NS	-.01	NS
SEED CV	-.39	.01	-.42	.05	-.42	.05
< 1 OZ.	-.10	NS	-.08	NS	-.15	NS
1.0 - 1.5	-.13	NS	-.01	NS	-.14	NS
1.5 - 2.5	+.16	NS	+.04	NS	+.19	NS
2.5 - 3.0	+.10	NS	+.11	NS	+.12	NS
73.0	-.09	NS	-.09	NS	-.07	NS

```
 Tol.      1.30 oz
<TU1       1.02 oz
<TU2       0.71 oz
<TU2       0.97 oz
<TU1       1.13 oz
<TU1       1.21 oz
           1.83 oz
<TU2       0.54 oz
<TU1       1.33 oz
           1.82 oz
>TO1       2.60 oz
<TU1       1.45 oz
           1.78 oz
           1.94 oz
<TU2       0.98 oz
<TU1       1.23 oz
<TU1       1.39 oz
           1.51 oz
<TU2       0.56 oz
           1.88 oz
<TU2       0.45 oz
<TU2       0.99 oz

n           127
Mean       1.46 oz
Std.       0.54 oz
>TO2          1
>TO1          5
<TU1         71
<TU2         26


--------------------


Nom.       2.00 oz
Tol.       0.50 oz

Samples       1
n           127
Mean       1.46 oz
Std.       0.54 oz
>TO2       0.79 %
>TO1       3.94 %
<TU1      55.91 %
<TU2      20.47 %
```

EVALUATION OF POTATO TOP KILLERS

K.V. McCully, M. Mann, D. Hanscomb, and J. Lavoie

ABSTRACT: A trial to evaluate and compare three new potential potato topkillers with diquat was conducted. Visual assessments on leaf and stem desiccation, yields and specific gravity were collected. Results indicated that diquat treatments resulted in the fastest leaf and stem desiccation. This was followed by UBI 9086 and HOE 39866 treatments, of which there was very little difference. By the final assessment date all treatments except lactofen resulted in over 85% leaf and 78% stem desiccation and were not significantly different from one another. HOE 39866 and UBI 9086 were therefore as effective as diquat in desiccating the potato tops. Specific gravity readings indicated that the treatments with the fastest topkill, resulted in the lowest specific gravity readings. No clear trends were observed from yield data.

ÉVALUATION DE DÉFANANTS

Résumé: Un essai a eu lieu pour évaluer et comparer l'efficacité de trois nouveaux défanants possibles et du diquat. On a fait l'évaluation visuelle de la dessiccation des feuilles et des tiges, du rendement et de la densité relative. Les résultats ont indiqué que le diquat provoquait la dessiccation la plus rapide des feuilles et des tiges, suivi de très près par le HBI 9086 et le HOE 39866. À la date de la dernière évaluation, tous les produits sauf le lactofen avaient causé la dessiccation de 85 p. 100 des feuilles et de 78 p. 100 des tiges, sans constater d'écarts importants entre eux. On a donc conclu que le HOE 39866 et le UBI 9086 étaient aussi efficaces que le diquat pour le défanage. Les lectures de la densité relative indiquent que les traitements au défanant le plus rapide correspondaient à la densité relative la plus faible. Les données recueillies pour le rendement n'ont pas permis d'établir une tendance définie.

INTRODUCTION: One of the common production practices associated with potato growing is top killing. Top killers are used to facilitate potato harvesting, control tuber size, reduce skinning, and reduce losses due to diseases. A relatively slow but complete kill of the potato leaves and vines is most desirable. This type of kill will produce the highest quality tubers (high starch content), permit some additional tuber sizing and provide conditions for a good skin set (Advisory Committee on Potatoes, 1987). A slow kill will also allow tubers to continue converting sugars to starch, something vital to good processing quality. Top killing is therefore considered to be very important.

The banning of dinoseb by the N.B. Department of Environment(effective Nov.1,1990),has left only one product,diquat, registered for potato top killing.There have been some concerns expressed from the use of diquat and as a result it is felt that other potential products should be evaluated. A trial was therefore initiated to evaluate various herbicides as potential potato top killers.

MATERIALS AND METHODS: The trial was established in a commercial planting of Russet Burbank potatoes in Bedell, Carleton county,
N.B.. Potatoes were planted in a silt-clay loam soil having a pH of 6.4 and an organic matter level of 3.9%. Experimental design was a randomized complete block with four replicates. Plots contained three 5 m long rows with results taken from the centre row only. The two outer

rows served as guards. Treatments (see table 1) were applied September 14 with a CO_2 backpack sprayer in a water volume of 300 L/Ha. Sprayer pressure was 200 kPa. Visual assessments on leaf and stem desiccation were taken September 17, September 20 and October 2. Yields were taken October 2 from the centre row in each plot. Logarithmic transformations were performed on yields and arcsin transformations were performed on the visual observations where necessary. Means were separated using Duncan's multiple range test.

RESULTS AND DISCUSSION:

Leaf & Stem Desiccation

Leaf and stem desiccation ratings were taken to give a visual indication of treatment efficacy. September 17 leaf desiccation ratings (3 days after application) indicated that all treatments except lactofen resulted in significant leaf desiccation as compared to the untreated control. Desiccation ratings ranged from 28.8 to 72.5% for the treatments which were significantly higher than the control. The two fastest reacting treatments were diquat 0.84 kg(a.i.)/ha (72.5%) and diquat 0.42 kg(a.i.)/ha (60.0%) (See Table 1). Stem desiccation ratings at this time were much lower as none of the treatments resulted in over 10% desiccation.

Leaf and stem desiccation ratings collected September 20 (6 days after application) indicated that all treatments further increased top kill levels. All treatments resulted in significantly higher desiccation levels than the control. Leaf desiccation ratings ranged from 46.3% to 91.3% and stem desiccation ratings from 17.5 to 38.8%. The high and low rate of diquat continued to provide the highest percentage leaf (91.3%, 86.3%) and stem(38.8%,33.8%) desiccation levels respectively (see Table 1). Overall at this time diquat treatments resulted in the highest leaf desiccation followed by Hoe 39866, UBI 9086 and lactofen. Differences were not always significant however. Differences were less evident from stem desiccation ratings, as treatments other than diquat were not significantly different from one another.

By the final rating period, October 2, (18 days after application) differences between treatments were less evident. All treatments remained significantly higher than the untreated control plots for both leaf and stem desiccation. Treatments resulting in over 85% leaf topkill included diquat (0.84 kg(a.i.)/ha) (100%); diquat (0.42 kg(a.i.)/ha (100%); Hoe 39866 (0.55 kg(a.i.)/ha) (100%); UBI 9086 (0.14 kg(a.i.)/ha (90.0%); UBI 9086 (0.07 kg(a..)/ha) (90.0%); and Hoe 39866 (0.45 kg (a.i.)/ha) (88.8%). These treatments were not significantly different from one another, however. Lactofen resulted in the lowest level of top kill (68.8%), only slightly higher than the control (52.5%). Top kill in the control plots were the result of natural senescence and slight frosts.

Stem desiccation ratings at the final assessment date were similar to leaf desiccation ratings, with the treatments providing the highest levels of leaf desiccation also providing the highest stem desiccation levels. All treatments except lactofen resulted in over 78% stem desiccation, and were not significantly different from one another.

Overall, diquat treatments resulted in the fastest leaf and stem desiccation followed by Hoe 39866 and UBI 9086 treatments. There was very little difference between the UBI 9086 and Hoe 39866 treatments, however. Lactofen was the slowest reacting of all the treatments evaluated. The lower rates of UBI 9086, diquat and Hoe 39866 were just as effective as the higher rates.

SPECIFIC GRAVITY

Specific gravity was measured to give an indication of potato quality and therefore starch content. The higher the starch content the higher the potato quality. If a potato top killer works too fast there will be less translocation of sugars from the upper plant parts to the tuber, where the sugar is converted to starch. Therefore the faster the topkill, the lower the specific gravity, the lower the starch content,and the lower the quality. Generally, depending upon conditions, specific gravity of Russet Burbanks range from 1.085 to 1.090.

Specific gravity readings, although not significantly different from one another, indicated that all treatments reduced specific gravity as compared to the untreated control. The two lowest specific gravity readings came as expected from the two fastest acting topkiller treatments, diquat (0.84 and 0.42 kg(a.i.)/ha). The untreated control plots had the highest specific gravity (1.087). The remaining treatments were all very close with specific gravity readings between 1.081 and 1.083.

YIELDS

Yield data indicated that the highest yielding treatment was diquat (0.84 kg(a.i.)/ha) (52.32 T/ha) followed by the untreated control (50.35 T/ha). The diquat 0.84 kg(a.i.)/ha treatment high yields were unexpected as it had the fastest topkill, which would have expectedly reduced tuber sizing. Only one treatment, HOE 39866 (0.55 kg(a.i.)/ha) resulted in significantly lower yields than the untreated control. Diquat at the lower rate (0.42 kg(a.i.)/ha) was surprisingly and unexplainably lower in yield than the full rate of diquat. The lower rate of UBI 9086 and HOE 39866 resulted in yields greater than the high rates of these products but not significantly. Extremes in climatic conditions throughout the growing season may have accounted for some of the variations in yields.

CONCLUSIONS: Overall the fastest leaf and stem desiccation resulted from the two diquat treatments. This was followed by Hoe 39866 and UBI 9086 treatments, of which there was little difference. Lactofen was the slowest reacting of treatments tested. By October 2, all the treatments except the control and lactofen resulted in over 85% leaf and 78% stem desiccation. These treatments were not significantly different from one another. The lower rates of UBI 9086, diquat and Hoe 39866 were just as effective as the higher rates. Control plots had a natural leaf and stem desiccation of 52.5 and 28.8% respectively.

To determine the treatments effects on quality, specific gravity was taken. The highest specific gravity and quality, resulted from the untreated control. Although having the highest specific gravity at this time it is possible that problems such as disease infestation and increased bruising could develop and appear when in storage. The treatments with the fastest topkill activity (diquat) resulted in the lowest specific gravity. This was expected since less sugar would translocate to the tubers and be converted to starch with a rapid knockdown. Yields varied between treatments, but the only treatment significantly lower than the untreated control was HOE 39866 (0.55 kg(.ai.)/ha). This and the fact that the low diquat rate resulted in significantly lower yields than the high rate is surprising. It is felt that extremes in climatic conditions throughout the growing season may have been responsible for these unexpected results.

Based on the preliminary results, it appears that a slightly higher quality potato may be expected from potatoes not treated with diquat. The UBI 9086 and Hoe 39866 treatments, although initially slower reacting than diquat, were still effective as top killers. By the last assessment date there were no significant differences between these treatments and diquat. Lactofen was very slow in desiccating tops as compared to the rest. More work needs to be conducted to further evaluate the topkillers.

ACKNOWLEDGEMENTS: Appreciation is extended to Donnie Keenan for providing the trial site and for his cooperation throughout the trial.

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TABLE 1- YIELDS, SPECIFIC GRAVITY AND LEAF AND STEM DESICCATION RATINGS

	treatment	rate kg a.i./ ha	Sept. 17 3 days after application		Sept. 20 6 days after application		Oct. 2 18 days after application		YLD	S.G.
			LD	SD	LD	SD	LD	SD	MT/ha	
1	Control	-	7.5 d	2.5 c	16.3 e	5.0 c	52.5 c	28.8 c	50.35 ab	1.087 n.s.
2	UBI 9086	.07	28.8 c	6.3b	62.5c	20b	90a	81.3a	46.17abc	1.082
3	UBI 9086	.14	36.3c	5 bc	66.3bc	23.8b	90 a	78.8a	41.38 bc	1.081
4	diquat	.84	72.5a	10a	91.3 a	38.8a	100 a	98.8 a	52.32a	1.078
5	diquat	.42	60 b	10 a	86.3 a	33.8 a	100 a	98.8 a	43.21 abc	1.080
6	Hoe 39866	.45	30 c	3.8 bc	71.3bc	21.4b	88.8a	87.5a	49.40 abc	1.083
7	Hoe 39866	.55	33.8 c	5.0 bc	73.8b	17.5 b	100	96.3a	40.47 c	1.081
8	Lactofen	0.50	13.8d	5 bc	46.3 d	18.8b	68.8b	52.5 b	50.35 ab	1.082

Means with the same letter are not significantly different at the 0.05 level of significance according to Duncans Multiple Range Test.
LD= leaf dessication ; SD= stem dessication
S.G.= specific gravity

EFFECT OF DIFFERENT RATES OF GYPSUM ON YIELD AND SCAB INCIDENCE IN THE POTATO CULTIVAR SHEPODY

R.P.Hinds and A.F. Perley

ABSTRACT: Shepody potato cultivar (scab-susceptible) was planted on the Holmesville soil series (pH 6.1), naturally infested with common scab (Streptomyces scabies). Plots were top-dressed post-planting, with 0, 672, 1344 and 2016 kg/ha of gypsum in a RCBD. Gypsum treatments had no significant effect on total yield or scab incidence in this year's work, though all the gypsum plots produced slightly higher total yields of tubers with little or no scab than the control. Previous work showed 672 kg/ha was best for yields and scab reduction. Scab incidence was very low, in general, in Shepody grown this year.

Like in previous work, gypsum treatments had no significant effect upon specific gravity, french fry color, sucrose content, hollow heart, stem-end browning, tuber periderm %Ca or leaflet %Ca in Shepody. After two years work, gypsum at the rate of 672-1344 kg/ha would appear to offer the best yields and scab reduction in cultivars like Shepody and Kennebec.

EFFETS DE DIFFÉRENTS TAUX DE GYPSE SUR LE RENDEMENT ET SUR LA SENSIBILITÉ À LA GALE DU CULTIVAR DE POMME DE TERRE SHEPODY

Résumé: Un cultivar de pomme de terre Shepody sensible à la gale a été planté dans des sols de type Holmesville (pH de 6,1) naturellement infestés par la gale commune (Streptomyces scabies). Après la plantation, on a épandu du gypse sur les parcelles d'essai d'un dispositif expérimental en bloc divisé au hasard à raison de 0, 672, 1 344 et 2 016 kg par hectare. L'application de gypse n'a eu aucun effet important cette année sur le rendement total ou sur la sensibilité à la gale, même si la gale était complètement absente, ou presque, et que le rendement total de tubercules était un peu plus élevé dans la parcelle traitée au gypse par rapport à la parcelle témoin. Les travaux précédents avaient indiqué que l'application de 672 kg par hectare était celle qui donnait les meilleurs rendements et qui réduisait le plus les taux de gale. En général, les taux de gale étaient très bas dans le cultivar Shepody soumis à l'essai cette année.

INTRODUCTION: Common scab caused by a gram positive filamentous bacterium **Streptomyces scabies** is a ubiquitous, well adapted soil inhabitant, that reduces the quality of yield in susceptible potato cultivars. Anderson and Lorang (1988) reported that the disease can be minimized by crop rotations, irrigation, incorporation of green manures, the addition of sulphur in the form of gypsum or sulphur dust or by pentachloronitrobenzine (PCNB). Davis et al. (1976) hypothesized that the effects of various control measures which reduced scab could be explained by the resulting increase in Ca level of the potato plant but this has yet to be verified. Davis et al. (1974) demonstrated that both elemental S and gypsum reduced scab and soil pH when applied to soil, which had a pH of 7.7. However, they indicated that the reduction in soil pH was not sufficient to account for disease suppression. Ca levels in the tuber peelings were found to be lower than in the untreated plots, suggesting that the reduction of the disease was indirect and due to a decrease in Ca in the tuber peelings. Davis et al. (1976), subsequently indicated that the concentration of Ca in the tuber periderm may be positively correlated with susceptibility to scab. These workers also noted that low soil moisture which increases scab, also resulted in higher Ca concentrations in tuber peelings. Kelman et al. (1989) reported that raising tuber Ca concentration reduces bacterial soft rot susceptibility in potatoes. It was reported by other workers, that pre-plant strip application of sieved $CaS0_4$, was one of the best Ca sources for improving tuber grade and quality. Kelman et al. (1989) reported normal Ca in tuber periderm ranges from 0.057-0.277%. Simmons and Kelling (1987) found that on low Ca tested soils, gypsum did not affect total potato yield, but increased tuber grade and quality at rates of up to 1500 lbs. gypsum/Ac (300 kg Ca/ha). These improvements were accompanied by increased tuber periderm Ca concentrations, even though leaflet Ca concentrations were unaffected. On high Ca tested soils, responses were inconsistent, and tuber periderm Ca was generally not increased. Kelman et al. (1989) reported that tuber Ca concentration is strongly influenced by Ca concentrations in the hill surrounding the tuber as it develops, and direct movement of Ca into the tuber takes place from the soil either directly through the periderm, or through the stolon and tuber roots. It was found that sieved $CaS0_4$ applied (1500 lbs/ac) either broadcast, in a preplant strip or as a side-dress, were effective in increasing Ca concentration in the tuber. Consequent upon the foregoing, it was decided to examine the effects of gypsum ($CaS0_4 \cdot 2H_20$) applied top-dressed post-planting, upon scab incidence, yield and tuber periderm Ca concentration in Shepody, a scab susceptible potato cultivar, over a three year period.

METHOD: Plots on the Holmesville clay loam soil series with a 10-year history of scab were identified for the purpose of this three year study. The soil tested medium for Ca-levels (1200-2000 kg/ha) under NB Standards. Shepody (cut-seed) was planted on May 20 at 25 cm intro-row spacing. gypsum was applied top-dressed at the rate of 0, 672, 1344 and 2016 kg/ha. Cultivations and hilling allowed the gypsum to remain in the hill where the tubers were to develop. An RCBD was employed. Soil analyses were taken prior to and 8 weeks post planting - latter being during the period of initiation and early tuber development. Plot size was 55.8m^2. Gypsum used was 22% Ca and 16% S. Tuber periderm was removed with a carrot peeler for analysis.

The first three weeks of July were dry during tuber initiation and early development. Conditions were conducive to scab development. Scab was determined as per key in the Can. Plant Dis. Surv. 51: 1971.

The crop was harvested on September 18, 1990.

RESULTS AND DISCUSSION: **Soil Analyses:** Mean soil analyses results for the gypsum treatments are given in Table 1. Hinds and Ghanem (1983) found that pH had little effect on scab incidence as infection occurred at low, medium and high pH ranges. In this work, it was decided to examine the effects of gypsum on soils with the initial pH around 6.0 with medium Ca soil levels for the second year in a row. Table 1 shows that after 8 weeks, all the gypsum plots showed an increase in Ca levels with pH near 7.0. These combined with a dry July at the time of tuber initiation should have created the right conditions for scab development in soils known to predispose to the disease.

TABLE 1: Mean Soil Analyses at Four Levels of Gypsum on Shepody Potato Cultivar - 8 Weeks Post-Planting.

		Soil Analyses				
			kg/ha			
Treatment	pH	% O.M.	P_2O_5	K_2O	Ca	Mg
1. 0 kg/ha gypsum	6.6	3.7	210	272	2283	123
2. 672 kg/ha gypsum	7.5	2.9	307	363	3431	94
3. 1344 kg/ha gypsum	7.0	3.7	215	252	3051	162
4. 2016 kg/ha gypsum	7.2	3.3	235	235	3505	109

YIELD: The different gypsum rates did not produce any significant differences in total yield or the various yield sizes. The best total yield was however, produced by 1344 kg/ha gypsum. Last year 672 kg/ha gypsum was significantly better than the control (Hinds and Perley, 1989).

Scab Incidence and Tuber Periderm %Ca: Table 3 shows data on scab incidence and tuber periderm %Ca in Shepody, as affected by four levels of gypsum. All the gypsum plots produced a slightly higher yield of potatoes with little or no scab than the control, but there were no significant differences between the treatments in relation to scab, tuber %Ca or leaflet %Ca. Last year (Hinds and Perley, 1989), similar work on Shepody showed that 672 kg/ha gypsum produced a significantly higher yield of tubers with little or no scab compared to the control. Simmons and Kelling (1987) reported that in higher soil test Ca soils, similar to the one in this trial, responses to gypsum were inconsistent and periderm %Ca concentration was generally not increased. Also leaflet %Ca was unaffected by gypsum treatments. The results here are quite similar to those reported by Simmons and Kelling. In general, scab incidence was very low this year with susceptible cultivars.

TABLE 2: Yield of Shepody as Affected by Four Levels of Gypsum.

	Yield t/ha			
Treatment	<30m	30-60mm	>60mm	Total
1. 0 kg/ha gypsum	0.25	16.46	15.45	32.16
2. 672 kg/ha gypsum	0.35	15.85	16.66	32.86
3. 1344 kg/ha gypsum	0.40	15.24	18.69	34.33
4. 2016 kg/ha gypsum	0.70	15.44	17.68	33.82

(Treatment Means - not significant at 0.05 level).

TABLE 3: Scab Incidence, Tuber Periderm %Ca and Leaf %Ca in Shepody as Affected by Four Levels of Gypsum.

			Yield t/ha % Tuber - Scab Lesions	
Treatment	Leaflet % Ca	Tuber Periderm %Ca	0-10%	>10%*
1. 0 kg/ha gypsum	0.95	0.12	32.10	0.06
2. 672 kg/ha gypsum	0.85	0.13	32.86	0.00
3. 1344 kg/ha gypsum	0.93	0.11	34.33	0.00
4. 2016 kg/ha gypsum	1.01	0.13	33.82	0.00

(Treatment Means - not significant at 0.05 level).
* Not acceptable by Trade.

Hollow Heart and Stem-End Browning: Neither hollow heart nor stem-end browning were affected by gypsum application. This was similar to what was found last year where hollow heart was nil and stem-end browning was negligible.

Specific Gravity, French Fry Color and Sucrose Content: Gypsum treatments had no significant effect upon specific gravity, french fry color or sucrose content of Shepody (Table 4). These results are similar to what was reported last year (Hinds and Perley, 1989).

TABLE 4: Tuber Specific Gravity, French Fry Color and Sucrose content of Shepody as Affected by Four Levels of Gypsum.

Treatment	Mean Specific Gravity	Mean French Fry Color*	Mean Sucrose Content mg/g
1. 0 kg/ha gypsum	1.068	1.3	1.27
2. 672 kg/ha gypsum	1.073	1.3	1.02
3. 1344 kg/ha gypsum	1.069	1.5	1.51
4. 2016 kg/ha gypsum	1.071	3.0	1.14

(Treatment Means - not significant at 0.05 level).
* USDA equivalent (0-4) is acceptable by Trade.

CONCLUSIONS: Gypsum treatments had no significant effect upon total yield, the various yield sizes, scab incidence, specific gravity, french fry color, sucrose content, hollow heart or stem-end browning. Previous work suggested that the 672 kg/ha produced significantly better total yields and less scab incidence. However, like previous work, all the gypsum treatments produced a slightly better total yield of tubers with little or no scab than the control. Tuber periderm %Ca and leaflet %Ca were also unaffected significantly by the gypsum treatments. The latter seems to be the case for soils which test high in Ca. After two years work, gypsum applications between 672-1344 kg/ha would appear to be best for total yield and scab reduction in susceptible cultivars like Shepody and Kennebec.

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RESPONSE OF RUSSET BURBANK POTATO CULTIVAR TO DIFFERENT CALCIUM TREATMENTS

R.P. Hinds and G. Pelletier

ABSTRACT: Different calcium carriers were applied to Russet Burbank potato cultivar on the Holmesville soil series to examine their effects upon yield, tuber quality and tuber periderm %Ca. The treatments were N-hib Ca in a split application (75 kg/ha N + 33 kg/ha Ca); Calcium nitrate 224 kg/ha (43 kg/ha Ca + 35 kg/ha N); gypsum 672 kg/ha (147 kg/ha Ca); Cal-U-Sol 168 kg/ha (34 kg/ha Ca + 17 kg/ha S + 8 kg/ha Mg) and control where no calcium was applied. The treatments had no significant effects on total yield, yield sizes, specific gravity, french fry color, hollow heart or stem-end browning. N-hib Ca however, produced significantly lower sucrose levels in tubers after harvest than the control or Cal-U-Sol. The treatments also produced no significant differences in leaf and petiole or tuber periderm %Ca, %Mg or %K. The highest tuber periderm %Ca were however, noted in gypsum and N-hib Ca treatments.

The results are similar to what was reported a year earlier in relation to most factors except that Cal-U-Sol was the dominant treatment with respect to yield.

RÉACTION DU CULTIVAR DE POMME DE TERRE RUSSET BURBANK À DIVERS TRAITEMENTS AU CALCIUM

Résumé: Divers produits à base de calcium ont été appliqués à un cultivar de pomme de terre Russet Burbank cultivé dans un sol de type Holmesville pour évaluer l'effet de cette application sur le rendement, sur la qualité du tubercule et sur la teneur en calcium de la pelure. Les traitements ont consisté en une application combinée de N-hib Ca (75 kg d'azote et 33 kg de calcium per hectare), une application de 224 kg de nitrate de calcium par hectare (43 kg de calcium et 35 kg d'azote par hectare), une application de 672 kg de gypse par hectare (147 kg de calcium par hectare), une application de 168 kg de Cal-U-Sol par hectare (34 kg de calcium, 17 kg de soufre et 8 kg de magnésium par hectare), et une parcelle témoin dans laquelle on n'avait pas appliqué de calcium. Les traitements n'ont pas eu d'effet considérable sur le rendement total, la grosseur des tubercules, la densité relative, la couleur des frites, le coeur creux, ou le brunissement du talon. On a observé que le taux de sucrose présent dans les tubercules après la récolte était beaucoup moins considérable dans les parcelles traitées au N-hib Ca que dans la parcelle témoin ou que dans les parcelles traitées au Cal-U-Sol. De plus, les traitements n'ont pas modifié sensiblement la feuille et le pétiole ni la teneur de la pelure en calcium, en magnésium, ou en potassium. On a toutefois noté que la plus haute teneur en calcium de la pelure était associée aux traitements avec le gypse et le N-hip Ca.

Les résultats sont semblables à ceux enregistrés l'année précédente pour la plupart des facteurs, sauf que le Cal-U-Sol représentait alors le meilleur traitement pour le rendement.

INTRODUCTION: The importance of calcium (Ca) in the production of peanuts has been well documented and it is only in recent years that attention has been focused on Ca nutrition in potato tuber health and development. Several researchers have shown the importance of high Ca concentration in the potato tuber to be necessary to reduce bacterial soft rots (Engelhard, 1989). Problems with Ca deficiency in potatoes are localized in the tuber and not the foliage. This is a result of several factors. Firstly, Ca is taken up by the roots and moves exclusively through the xylem to the leaves - the tubers are by-passed. Secondly, Ca in the leaves does not move back down to the tubers as movement of Ca in phloem is minimal. Thirdly, tubers and stolons must take up needed Ca directly from the soil through their unsuberised tips. As a result, proper Ca nutrition of tubers requires stolons and tubers to be immediately surrounded by high levels of calcium.

Thorne (1989) reported that Internal Brown Spot (IBS), a disorder in tubers prevalent under conditions of intense summer temperature changes and rapid vine growth, is the result of inadequate Ca nutrition. It is postulated that since the foliage of potato plants compete for Ca with the tuber, under rapid vine growth and rapid moisture withdrawal, Ca may actually be pulled away from the tuber resulting in IBS. Liquid calcium ammonium nitrate 17 (CAN 17 - 8% Ca; 11.6% nitrate N), supplying 28 kg/ha of Ca was found to be as effective for increasing Ca content of the potato tuber periderm as 252 kg/ha of calcium supplied through 509 kg. of gypsum; and thus reducing IBS. Indeed, Ca% in the tuber periderm has been shown to be a good indicator of Ca content of the tuber itself. Engelhard (1989) reported ranges of Ca in the tuber periderm to be 0.057 - 0.277%.

Simmons et al (1988) have shown that gypsum (pelleted, sieved or granulated) applied broadcast, side-dressed or in a preplant strip is an excellent source of Ca and effective in increasing tuber periderm Ca concentration. Stoller (1989) in setting up a model for Ca as the "second messenger", stated that Ca will move into the tuber, only if the tuber loses water, and further that when potatoes are heavily watered, tubers closer to the soil surface will often have fewer Ca related problems, because they lose more moisture.

Stoller (1989), in recognizing that Ca allows the crop to use more ammonium nitrogen, introduced a product called N-hib Calcium - a calcium/urea formulation (18% N; 8% Ca) for use in potatoes and other crops. Increased yields, increased tuber periderm %Ca, increased phosphate in petioles, increased K and Mg in tissues, better quality and higher specific gravity have all been associated with the use of the product, (Stoller, 1989). With all this increasing emphasis on Ca and potato yields, it was decided to examine several calcium supplying products over the next 2 years, to observe their effects on potato yield and quality and tuber periderm %Ca. It was decided to examine the following products:

- N-hib Calcium - 18% N; 6% Ca.
- Gypsum - 22% Ca; 16% S.
- Cal-U-Sol - 20% Ca; 10% S and 4.5% Mg.
- Calcium nitrate - 19% Ca; 15.5% N.

METHODS: Cut seed (60g approximately) of Russet Burbank was planted on the Holmesville clay loam soil series (pH 5.4) on May 28, 1990. Rotation in the field was potatoes, clover, clover, potatoes. A RCBD was employed and the following treatments were imposed:

Treatments

1. Basic fertilizer application - 1232 kg/ha 15-15-15 banded at planting with no calcium - control.

2. Basic fertilizer application - 1232 kg/ha 10-20-20 banded at planting plus 112 L/ha N-hib Ca (9% N, 9% Ca) sprayed on two of the rows at planting + 326 L/ha N-hib Ca (18% N, 6% Ca) side-dressed on July 12.
   - Density of N-hib Ca - 5.76 kg/4.5 L.

3. Basic fertilizer application - 1232 kg/ha 12-15-15 banded at planting plus 224 kg/ha calcium nitrate (19% Ca; 15.5% N) side-dressed on July 3.

4. Basic fertilizer application - 1232 kg/ha 15-15-15 banded at planting plus 672 kg/ha of gypsum (22% Ca, 16% S) top-dressed post-planting on May 29.

5. Basic fertilizer application - 1232 kg/ha 15-15-15 banded at planting plus 168 kg/ha Ca.-U-Sol (20% Ca, 10% S, 4.5% Mg) mixed in with the fertilizer.

The crop was harvested on October 18. Soil and leaf analyses were taken at mid-season. Tuber periderm %Ca was determined by peeling tubers with a carrot peeler. The month of July was dry during the period of tuber development.

RESULTS AND DISCUSSION: Soil Analyses: Table 1 shows the mean soil analyses at 8 weeks post application of treatments. Plots were selected with low Ca levels (<1000 kg/ha Ca) to generate the greatest effect from the applied calcium treatments. Only the gypsum had any measured effect upon the Ca level.

TABLE 1: Mean Soil Analyses of Different Calcium Treatments 8 Weeks Post Application.

		Soil Analyses kg/ha			
Treatments	pH	P_2O_5	K_2O	Ca	Mg
1. No calcium	5.6	513+	416	871	60
2. Calcium nitrate - 224 kg/ha	5.7	513+	450+	956	57
3. N-hib Ca	5.7	513+	450+	905	34
4. Gypsum - 672 kg/ha	5.7	513+	450+	1257	33
5. Cal-U-Sol - 168 kg/ha	5.7	513+	450+	898	73

YIELDS: Table 2 shows the yield of the Russet Burbank cultivar with different calcium treatments. All treatments gave an excellent yield though not significantly different from each other. This is similar to what was observed last year.

Cal-U-Sol and calcium nitrate produced the highest total yield but the N-hib Ca produced the least off-type tubers. In last year's work, Cal-U-Sol produced the least off-type tubers. Like in the previous year, Cal-U-Sol produced the highest marketable yield. Cal-U-Sol treatments did not senesce earlier than other treatments as it did the previous year.

TABLE 2: Effect of Different Calcium Treatments on Yield of Russet Burbank Potato Cultivar.

	Yield t/ha			
Treatment	Undersized (<84g)	Marketable (84->283g)	Off Type	Total
1. No calcium	6.40	32.85	1.34	40.59
2. Calcium nitrate 224 kg/ha	5.92	34.70	2.04	42.66
3. N-hib Ca	5.86	34.80	0.85	41.51
4. Gypsum-672 kg/ha	6.37	30.46	2.47	39.30
5. Cal-U-Sol-168 kg/ha	5.58	35.55	2.40	43.53

(Treatment Means - not significant at 0.05 level)

Specific Gravity, Sucrose Content, French Fry Color: Table 3 shows the data for the effect of the various calcium treatments on specific gravity, french fry color and sucrose content after harvest. The treatments had no significant effect upon specific gravity or french fry color. N-hib Ca however, produced a significantly lower sucrose content in tubers than the control or Cal-U-Sol. Last year's treatments produced no significant differences among the treatments in relation to these qualities (Hinds and Pelletier 1989).

TABLE 3: Effect of Different Ca Treatments on Specific Gravity, Sucrose Content and French Fry color of Russet Burbank.

Treatment	Specific Gravity	Sucrose Content mg/g	French Fry Color
1. No calcium	1.07	1.71^{A}	1.9
2. Calcium nitrate 224 kg/ha	1.07	1.24^{BC}	2.1
3. N-hib Ca	1.07	1.04^{C}	2.2
4. Gypsum - 672 kg/ha	1.07	1.32^{ABC}	2.1
5. Cal-U-Sol - 168 kg/ha	1.07	1.52^{AB}	2.1

(Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other).

Stem-End Browning and Hollow Heart: Little or no stem-end browning and hollow heart were observed in the treatments. Less than 0.25% of the tubers had any defects.

Leaf and Petiole Analyses: Table 4 shows data in relation to leaf and petiole %Ca, Mg and K for all treatments at mid-season. There were no significant differences between treatments. Similar results were reported last year.

TABLE 4: Mean Leaf and Petiole Analyses on Russet Burbank at Mid-Season with Different Ca Treatments.

	%		
Treatment	Ca	Mg	K
1. No calcium	0.52	0.29	2.44
2. Calcium nitrate - 224 kg/ha	0.48	0.28	2.66
3. N-hib Ca	0.50	0.28	2.57
4. Gypsum - 672 kg/ha	0.56	0.28	2.61
5. Cal-U-Sol - 168 kg/ha	0.55	0.34	3.59

(Treatment Means - not significant at 0.05 level).

Tuber Periderm Analyses: Table 5 shows data on tuber periderm %Ca, Mg and K for all treatments after harvest. There were no significant differences between treatments with respect to these nutrients as was the case last year as well. However, gypsum and N-hib Ca had the highest level of %Ca in the periderm.

TABLE 5: Tuber Periderm Analyses on Russet Burbank With Different Calcium Treatments After Harvest.

Treatment	% Ca	% Mg	% K
1. No calcium	0.08	0.14	3.66
2. Calcium nitrate - 224 kg/ha	0.08	0.13	3.56
3. N-hib Ca	0.10	0.15	3.96
4. Gypsum - 672 kg/ha	0.12	0.14	3.65
5. Cal-U-Sol - 168 kg/ha	0.09	0.15	3.77

(Treatment Means - not significant at 0.05 level)

CONCLUSION: The different calcium treatments had no significant effect upon total yield and yield sizes, though Cal-U-Sol and calcium nitrate produced the highest yield. The calcium treatments had no significant impact on specific gravity, french fry color, hollow heart or stem-end browning. However, N-hib Ca produced significantly lower sucrose levels in tubers than the control or Cal-U-Sol. The treatments did not also produce significant differences in leaf and petiole or tuber periderm %Ca, Mg and K. The highest tuber periderm %Ca were noted in gypsum and N-hib treatments.

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EFFECT OF DIFFERENT RATES OF CALCIUM NITRATE ON YIELD OF RUSSET BURBANK

R.P. Hinds and G. Pelletier

ABSTRACT: Calcium nitrate was applied side-dressed at the rate of 0, 56, 112, 168 and 224 kg/ha to Russet Burbank potato cultivar at the time of tuber initiation to observe its effect upon yield, tuber quality and tuber periderm % Ca. None of the treatments had any significant effect on yield, specific gravity, french fry color, sucrose content, leaf or tuber periderm % Ca, % Mg or % K.

EFFET DE DIFFÉRENTS TAUX DE NITRATE DE CALCIUM SUR LE RENDEMENT DU CULTIVAR RUSSET BURBANK

Résumé: Le nitrate de calcium a été épandu en bandes latérales sur le cultivar de pomme de terre Russet Burbank à raison de 0, 56, 112, 168 et 224 kg par hectare pendant la période de formation du tubercule, afin d'observer l'effet de ces applications sur le rendement, la qualité du tubercule et la teneur en calcium de la pelure. Aucun des traitements n'a eu d'effet considérable sur le rendement, la densité relative, la couleur des frites, le taux de sucrose et la teneur des feuilles ou de la pelure en calcium, en magnésium ou en potassium.

INTRODUCTION: Calcium (Ca) is an essential nutrient for potatoes. Several disorders or diseases have been linked with Ca insufficiency or imbalance, including common scab, soft rot and internal brown spot. Soils in many potato growing areas, including N.B., have low available Ca. These soils typically have low pH, little lime and are in areas where natural precipitation has leached out much of the available Ca out of the soil profile. It is under these latter conditions that the above mentioned disorders have appeared.

It has become increasingly doubtful whether traditional soil and tissue testing for determining Ca sufficiency do in fact, indicate tuber needs over the growing season, because of the immobile nature of Ca in potato plants.

Ca has long been considered an immobile nutrient, that is, it moves from the site of uptake in the main roots up the plant to new leaf tissue. Ca does not readily move from vegetative tissue down to tubers. This characteristic suggests that conventional fertilization of Ca to the main roots of potato may not be the most efficient means of improving Ca absorption by tubers. Recent work at the Hancock Experiment Station, University of Wisconsin, suggests that the small roots located on the stolens and tubers are the primary contributors to Ca accumulation by tubers during the growing season. These results suggest that under conditions where increased Ca uptake is desired by tubers, Ca fertilizer placement during the growing season should be very near the stolens and tubers (Potato Grower of Id Report, 1990). Consequently, it has been decided to apply different rates of calcium nitrate to the hill during tuber bulking, to examine the effects upon yield and tuber periderm Ca %. The Ca in calcium nitrate is readily available for root uptake.

METHODS: Calcium nitrate was applied at the rate of 0, 56, 112, 168, 224 kg/ha side-dressed to Russet Burbank potato cultivar at the time of tuber initiation July 4-8, 1990. A RCBD was employed with 4 replications. Cultivations and final hilling allowed the calcium nitrate to remain in the hill where the tubers were to develop. Plots were selected on the Holmesville soil series where Ca levels were low (less than 1,000 kg/ha Ca). Plot size was 55.8m^2 and the calcium nitrate contained 19% Ca and 15.5% N. The crop was fertilized with 1,120 kg/ha 15-15-15 blend.

RESULTS AND DISCUSSION: Soil Analyses: Table 1 shows the mean soil analyses prior to planting. Plots were selected where the Ca levels were low to medium as best results have been reported under low Ca soil levels (< 1,000 kg/ha Ca) prior to treatment.

TABLE 1: Mean Soil Analyses of Different Calcium Treatments Prior to Planting

Treatment	Soil Analysis	kg/ha			
	pH	P_2O_5	K_2O	Ca	Mg
1. No calcium nitrate	5.9	513+	194	763	107
2. 56 kg/ha calcium nitrate	5.8	513+	170	778	95
3. 112 kg/ha calcium nitrate	6.1	513+	204	985	142
4. 168 kg/ha calcium nitrate	5.8	513+	223	956	158
5. 224 kg/ha calcium nitrate	6.0	513+	220	1009	166

YIELDS: Table 2 shows the yield of Russet Burbank cultivar with different calcium nitrate rates. All the treatments including the control gave an excellent yield, but there were no tubers > 283 g in size which may be directly related to the low K levels found in the leaf and petiole at mid-season (Table 4). The different rates had no significant effect upon yield though the higher levels of calcium produced higher yields.

Stem-End Browning and Hollow Heart: Less than 1% of the tubers had stem-end browning and hollow heart and there were no significant differences between treatments.

TABLE 2: Effect of Different Rates of Calcium Nitrate on Yields of Russet Burbank Potato Cultivar.

Treatment	yield t/ha Undersized (<84g)	Marketable (84-283g)	Total
1. No calcium nitrate	9.24	35.46	44.70
2. 56 kg/ha calcium nitrate	9.04	34.75	43.79
3. 112 kg/ha calcium nitrate	8.43	36.79	45.22
4. 168 kg/ha calcium nitrate	14.02	36.78	50.80
5. 224 kg/ha calcium nitrate	10.97	37.25	48.22

Specific Gravity, Sucrose Content and French Fry Color: Table 3 shows the data for the effect of the different rates of calcium nitrate on specific gravity, sucrose content and french fry color. None of the treatments had any significant effect upon these factors.

TABLE 3: Effect of Different Rates of Calcium Nitrate on Tuber Specific Gravity, Sucrose Content and French Fry Color of Russet Burbank

Treatment	Specific Gravity	Sucrose Content mg/g	French Fry* Color
1. No calcium nitrate	1.09	1.43	1.1
2. 56 kg/ha calcium nitrate	1.09	1.37	1.2
3. 112 kg/ha calcium nitrate	1.09	1.24	1.2
4. 168 kg/ha calcium nitrate	1.09	1.45	1.1
5. 224 kg/ha calcium nitrate	1.09	1.40	1.2

(Treatment Means - not significant at 0.05 level)
* French Fry Color 0-4 is acceptable by trade.

Leaf and Petiole Analyses: Table 4 shows data in relation to leaf and petiole %Ca, % Mg and %K for all treatments at mid-season. There were no significant differences between treatments but the %K levels were so low (normal range >3%) that yield sizes may have been adversely affected.

TABLE 4: Mean Leaf and Petiole Analyses on Russet Burbank with Different Rates of Calcium Nitrate at Mid-Season.

Treatment	%		
	Ca	Mg	K
1. No calcium nitrate	0.63	0.41	1.79
2. 56 kg/ha calcium nitrate	0.61	0.38	1.70
3. 112 kg/ha calcium nitrate	0.65	0.48	1.84
4. 168 kg/ha calcium nitrate	0.62	0.45	1.90
5. 224 kg/ha calcium nitrate	0.66	0.47	1.93

(Treatment Means - not significant at 0.05 level).

Tuber Periderm Analyses: Table 5 shows data on tuber periderm analyses for %Ca, %Mg and %K after harvest. Calcium nitrate applied at tuber initiation and bulking in the tuber zone was expected to raise Ca% levels in the tuber periderm. This was not in evidence as there were no significant differences observed in %Ca, %Mg or %K with the different treatments. The normal range for Ca% in the tuber periderm is 0.057 - 0.277.

TABLE 5: Tuber Periderm Analyses on Russet Burbank with Different Rates of Calcium Nitrate.

Treatment	%		
	Ca	Mg	K
1. No calcium nitrate	0.31	0.13	2.71
2. 56 kg/ha calcium nitrate	0.07	0.13	2.89
3. 112 kg/ha calcium nitrate	0.06	0.13	3.04
4. 168 kg/ha calcium nitrate	0.31	0.12	2.81
5. 224 kg/ha calcium nitrate	0.31	0.20	2.73

(Treatment Means - not significant at 0.05 level).

CONCLUSION: The different rates of calcium nitrate had no significant effect upon total yield, yield sizes. The latter may have been adversely affected by low K content as indicated by leaf and petiole analyses. The different treatments also had no significant effect upon stem-end browning, hollow heart, sucrose content, french fry color, leaf and petiole analyses of %Ca, %Mg, %K or tuber periderm analyses of %Ca, %Mg and %K.

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GREEN MANURE - GYPSUM EFFECTS ON YIELD AND SCAB INCIDENCE IN THE POTATO CULTIVAR SHEPODY - I

R.P. Hinds and A.F. Perley

ABSTRACT: Green manure strips (fallow, triple-mix, annual ryegrass and leger barley) were established in 1989 on the Holmesville clay loam soil series with a history of common scab caused by Streptomyces scabies. The strips were chopped and plowed down green in the fall of 1989. Imposed on the strips in the spring of 1990 were 4 levels of gypsum (0, 672, 1344 and 2016 kg/ha) in a split plot design, to investigate the effects of a green manure with gypsum on yield and scab incidence in the scab-susceptible potato cultivar, Shepody, in the absence of irrigation. This study is part of a program to develop, in the absence of varietal resistance, an integrated disease management program to effectively reduce scab under NB conditions.

The gypsum, green manure and their interactions had no significant effect upon total yield, scab incidence, hollow heart, stem-end browning, tuber periderm % Ca or leaf/petiole % Ca. No significant differences were observed between the treatments in relation to specific gravity, french fry color or sucrose content, though 1344 kg/ha gypsum was better than other treatments in this regard. Very little scab incidence was reported among scab-susceptible cultivars grown this year in NB.

EFFET DE L'ENGRAIS VERT ET DU GYPSE SUR LE RENDEMENT DE CULTIVARS DE POMME DE TERRE SHEPODY ET SUR LE TAUX DE GALE - 1

Résumé: En 1989, une jachère et des cultures de triple mélange, d'ivraie annuel et d'orge Léger ont été constituées pour servir d'engrais vert sur des bandes de terrains composés de loam argileux de type Holmesville habituellement infestés par la gale commune causée par **Streptomyces scabies**. Ces cultures ont été hachées et enfouies dans le sol à l'automne de 1989. Les bandes ont reçu en 1990 quatre applications de gypse (0, 672, 1 344 et 2 016 kg par hectare) dans un dispositif expérimental afin d'analyser les effets de l'engrais vert et du gypse sur le rendement et sur le taux de gale dans le cultivar de pomme de terre Shepody sensible à la gale, le tout en l'absence d'irrigation. Cette étude faisait partie d'un programme visant à mettre au point, en l'absence de résistance variétale, un programme complet de lutte contre la maladie pour réduire véritablement la gale dans le contexte du Nouveau-Brunswick.

Les applications de gypse et l'engrais vert, ainsi que leurs interactions, n'ont pas eu d'effet considérable sur le rendement total, le taux de gale, le coeur creux, le brunissement du talon, la teneur de la pelure en calcium ou la teneur de la feuille/du pétiole en calcium. Les divers traitements ne présentaient pas d'écart important en ce qui concerne la densité relative, la couleur des frites ou la teneur en sucrose, même si l'application de 1 344 kg de gypse par hectare s'est avérée meilleure que les autres traitements à cet égard. On a signalé un très faible taux de gale chez les cultivars sensibles à la gale qui ont été cultivés cette année au Nouveau-Brunswick.

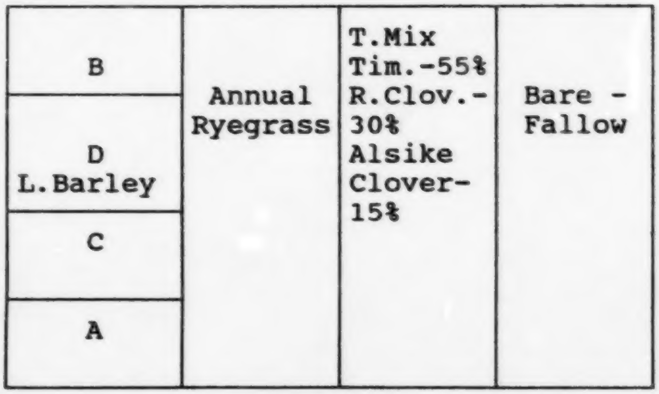
INTRODUCTION: Common scab of potato, when severe, can severely reduce the quality of an otherwise good marketable crop. According to Bergey's Manual of Determinative Bacteriology, the taxonomic position of the causal agent **Streptomyces scabies** is still uncertain, but for purposes of this discussion, the pathogen is being referred to as a gram positive filamentous bacterium (Anderson and Lorang, 1988).

Information about plant nutrients in relation to potato scab has been limited in general, to macro and micronutrients, nutrient concentration in soil and infrequently nutrient concentration in potato tubers.

Much of the literature on potato scab control deals with the application of nutrients to the soil which also affect soil pH. Under field conditions, disease incidence occurs over a range of pH, from very low 4.5 to over 8.0. But while disease incidence and severity may be pH related, high soil moisture has been shown, regardless of pH, to reduce scab (Hammerschmidt et al, 1989). Gypsum and elemental sulphur have been shown to reduce scab incidence. In addition to plant nutrients to manage scab, other control methods include seed treatments (Pentachloronitrobenzine PCNB), crop rotations, green manures, irrigation timing and varietal resistance (Engelhard ed: 1989, Anderson and Lorang, 1988).

Since **S**. **scabies** is ubiquitous and so well adapted, many workers feel no single control strategy will provide total disease control. Indeed elimination of scab may be both unfeasible and unnecessary, since growers, processors and consumers are willing to tolerate some blemishes on tubers. As a result, a three year effort is being designed to examine the combined effects of a green manure with gypsum, under rain-fed production in NB, in an effort to determine the degree of scab control in scab-susceptible commercial varieties on soils with long histories of the disease. This study represents only a preliminary look at the possible outcomes and will serve as a basis for work to be enjoined and continued.

METHOD: Strips of green manure crops were established in 1989 on the Holmesville clay loam soil series, naturally infested with the common scab, **Streptomyces scabies**. The strips were Fallow (bare), Triple Mix (Timothy 55%, Red clover 30%, Alsike clover 15%), Ryegrass and Leger Barley as shown below. A split plot design with 4 replications was employed.



Main Plot
Green Manures
Sub-Plot
Gypsum Rates
A-0 kg/ha
B-672 kg/ha
C-1344 kg/ha
D-2016 kg/ha

REP I

In 1989, fertilizer at the rate of 336 kg/ha of a blended 18-9-18 was applied to the green manures. Planting was completed on June 6, 1989. The strips were chopped on August 10, 1989 and fall plowed. Dry matter additions to the soil prior to chopping was estimated by random selection of 3 foot square portions of vegetation.

Shepody potato cultivar (scab-susceptible) was planted on May 20, 1990 and gypsum at the rate of 0, 672, 1344 and 2016 kg/ha were imposed on each strip. Gypsum used was 22% Ca and 16% S. Date of harvest was September 18, 1990. Main plots were 488 m^2 and sub-plots were 122 m^2. Data to be collected over the 3 year period include: O.M.%, soil analyses prior to and 8 weeks post-planting, leaf and petiole analyses at mid-season, yield (quantity and quality), hollow heart, tuber periderm % Ca, specific gravity, sucrose and french fry color. Scab incidence (tuber area % covered with lesions) was determined as per the key outlined in Can. Plant Dis. Surv. 51: 197.

Basic fertilizer on Shepody was 135 kg/ha N, P and K. The period of tuber initiation (1st three weeks of July) was dry.

RESULTS AND DISCUSSION: Soil Analyses: Mean soil analyses results for the green manure and gypsum treatments are given in Tables 1 and 2. Given the high pH, good O.M.% and high Ca levels on plots with a long history of scab, the probability of scab incidence was very high. Indeed, it was under conditions such as these that Davis et al (1974) demonstrated scab reduction by applying gypsum and elemental S to soil which had a pH of 7.7.

TABLE 1: Mean Soil Analyses at Four Levels of Gypsum on Shepody - 8 Weeks Post-Planting.

Gypsum Treatments	pH	% O.M.	kg/ha Ca
1. 0 kg/ha	6.9	3.4	2897
2. 672 kg/ha	7.2	3.3	3103
3. 1344 kg/ha	7.0	3.4	2774
4. 2016 kg/ha	7.0	3.3	2723

TABLE 2: Mean Soil Analyses Under Four Green Manure Treatments With Shepody - 8 Weeks Post-Planting.

Gypsum Treatments	pH	% O.M.	kg/ha Ca
1. Fallow	6.5	3.4	2420
2. Triple-Mix	7.1	3.4	3119
3. Ryegrass	7.3	3.2	3191
4. Leger Barley	7.3	3.3	3128
5. Fallow (prev.yr.)	6.9	3.5	2658

Dry Matter Additions: Table 3 shows dry matter additions to the soil after 10 weeks of growth in 1989. Leger barley added the greatest amount of dry matter to the soil. The fallow plots were harrowed twice to reduce the weed population but there was still dry matter additions from weeds that approached that from the triple-mix.

TABLE 3: Dry Matter Additions to the Soil From Green Manures - 10 Weeks Post-Planting, 1989.

Green Manure	t/ha Dry Matter Added	O.M.%
1. Fallow	2.90	3.4
2. Triple-Mix	4.25	3.4
3. Ryegrass	6.25	3.2
4. Leger Barley	9.50	3.3

The higher dry matter additions as green manures could be expected to have a greater effect on scab reduction. No significant change in O.M.% was observed from the dry matter additions after this first year.

Yield: Table 4 shows the mean yields for treatment effects (green manures, gypsum rates and their interactions). No significant differences were observed between green manure treatments, gypsum rates or gypsum/green manure interactions nor were there any observable trends in the yield data. Previous work (Hinds and Perley, 1989) through observation plots had indicated higher yields from red clover green manure versus a grass like timothy.

Scab Incidence: The literature is replete with work indicating that the incidence of scab is reduced through the addition of gypsum and sulfur (David et al, 1974), green manures, crop rotations (Anderson and Lorang, 1988) and green manures and irrigation (Hammerschmidt et al, 1989). Hinds and Perley (1989) in observation plots observed that red clover increased scab incidence in Yuko Gold, a yellow flesh cultivar. Hammerschmidt et al (1989) observed that red clover had significantly increased scab compared to other green manures. The incidence of scab in Shepody with four green manures and gypsum is given in Table 5. The incidence of scab was very low and no significant differences were observed between green manure treatments, gypsum rates or their interactions. The data showed no trends but it should be noted that very little scab was in evidence this year in scab-susceptible cultivars grown.

TABLE 4: Effect of Four Levels of Gypsum and Four Green Manure Treatments on Yield of Shepody Potato Cultivar.

	Yield-t/ha			
Treatment	<30mm	30-60 mm	>60mm	Total
Green Manures				
1. Fallow	0.37	18.19	18.04	36.60
2. Triple-Mix	0.48	19.38	14.58	34.44
3. Ryegrass	0.53	19.61	15.59	35.73
4. Leger Barley	0.24	19.53	16.81	36.58
Gypsum Rate				
5. 0 kg/ha Gypsum	0.32	19.91	16.29	36.52
6. 672 kg/ha Gypsum	0.33	19.69	15.59	35.61
7. 1344 kg/ha Gypsum	0.63	18.77	15.77	35.17
8. 2016 kg/ha Gypsum	0.35	18.34	17.37	36.06
Green Manure x Gypsum Rate				
9. Fallow x 0 kg/ha Gypsum	0.35	17.58	18.11	38.07
10. Fallow x 672 kg/ha Gyp	0.41	17.58	19.20	37.19
11. Fallow x 1344 kg/ha Gyp	0.35	19.31	17.58	37.24
12. Fallow x 2016 kg/ha Gyp	0.36	16.25	17.28	33.89
13. Trip-Mix x 0 kg/ha Gyp	0.45	22.26	11.89	34.60
14. Trip-Mix x 672 kg/ha Gyp	0.51	18.90	14.32	33.73
15. Trip-Mix x 1344 kg/ha Gyp	0.46	17.88	13.82	32.16
16. Trip-Mix x 2016 kg/ha Gyp	0.51	18.49	18.29	37.29
17. Ryegrass x 0 kg/ha Gyp	0.31	18.49	17.27	36.07
18. Ryegrass x 672 kg/ha Gyp	0.21	21.74	13.00	34.95
19. Ryegrass x 1344 kg/ha Gyp	1.31	20.52	14.83	36.66
20. Ryegrass x 2016 kg/ha Gyp	0.31	17.67	17.27	35.25
21. L.Barley x 0 kg/ha Gyp	0.16	19.30	17.88	37.34
22. L.Barley x 672 kg/ha Gyp	0.21	20.52	15.85	36.58
23. L.Barley x 1344 kg/ha Gyp	0.35	17.38	16.87	34.60
24. L.Barley x 2016 kg/ha Gyp	0.20	20.93	16.66	37.79

(Treatment means not significant at 0.05 level)

Leaf/Petiole and Tuber Periderm % Ca: No significant differences were observed between leaf/petiole and tuber periderm % Ca of the various treatments (Table 6). The data was similar for the green manure effects. In soils which test medium to high in Ca, tuber periderm % Ca has not been shown to be increased by further calcium additions by other workers.

TABLE 5: Effect of Four Levels of Gypsum and Four Green Manure Treatments on Incidence in Shepody Potato Cultivar.

	Yield-t/ha		
	Tuber Area With Scab Lesions		
Treatment	0-10%	>10%	Total
Green Manures			
1. Fallow	35.44	1.16	36.60
2. Triple-Mix	33.49	0.95	34.44
3. Ryegrass	34.57	1.16	35.73
4. Leger Barley	35.59	0.99	36.58
Gypsum Rate			
5. 0 kg/ha Gypsum	36.01	0.51	36.52
6. 672 kg/ha Gypsum	34.47	1.14	35.61
7. 1344 kg/ha Gypsum	33.84	1.33	35.17
8. 2016 kg/ha Gypsum	34.77	1.29	36.06
Green Manure x Gypsum Rate			
9. Fallow x 0 kg/ha Gypsum	37.22	0.85	38.07
10. Fallow x 672 kg/ha Gyp	36.19	1.00	37.19
11. Fallow x 1344 kg/ha Gyp	36.30	0.94	37.24
12. Fallow x 2016 kg/ha Gyp	32.04	1.85	33.89
13. Trip-Mix x 0 kg/ha Gyp	34.17	0.43	34.60
14. Trip-Mix x 672 kg/ha Gyp	32.85	0.88	33.73
15. Trip-Mix x 1344 kg/ha Gyp	30.76	1.39	32.16
16. Trip-Mix x 2016 kg/ha Gyp	36.19	1.10	37.29
17. Ryegrass x 0 kg/ha Gyp	35.45	0.62	36.07
18. Ryegrass x 672 kg/ha Gyp	33.77	1.18	34.95
19. Ryegrass x 1344 kg/ha Gyp	34.44	2.22	36.66
20. Ryegrass x 2016 kg/ha Gyp	34.62	0.63	35.25
21. L.Barley x 0 kg/ha Gyp	37.20	0.14	37.34
22. L.Barley x 672 kg/ha Gyp	35.08	1.50	36.58
23. L.Barley x 1344 kg/ha Gyp	33.86	0.74	34.60
24. L.Barley x 2016 kg/ha Gyp	36.22	1.57	37.79

(Treatment means not significant at 0.05 level)

TABLE 6: Mean Leaf/Petiole and Tuber Periderm % Ca of Shepody as Affected by Four Levels of Gypsum.

Treatment	Leaf/Petiole % Ca	Tuber Periderm % Ca
1. 0 kg/ha Gypsum	0.91	0.09
2. 672 kg/ha Gypsum	0.89	0.09
3. 1344 kg/ha Gypsum	0.93	0.10
4. 2016 kg/ha Gypsum	0.87	0.08

French Fry Color, Specific Gravity and Sucrose Content: Table 7 shows the specific gravity, french fry color and sucrose content of Shepody as affected by four levels of gypsum. No significant differences were observed between the treatments. Similar values for french fry color, specific gravity and sucrose content were noted under the green manure treatments. However, the highest specific gravity, the best fry color and the lowest sucrose content were noted under 1344 kg/ha gypsum.

TABLE 7: Specific Gravity, French Fry Color and Sucrose Content of Shepody as Affected by Four Levels of Gypsum.

Treatment	Specific Gravity	Fry Color* USDA Values	Sucrose mg/g
1. 0 kg/ha Gypsum	1.069	2.6	1.3
2. 672 kg/ha Gypsum	1.074	2.3	1.6
3. 1344 kg/ha Gypsum	1.075	1.7	0.7
4. 2016 kg/ha Gypsum	1.072	2.2	0.8

* USDA color of 1-4 is acceptable by Processing Trade.

Hollow Heart and Stem-End Browning: No stem-end browning was observed in tubers from the various treatments and hollow heart was negligible.

CONCLUSION: Gypsum/green manure treatments have had no significant effect upon total yield, the various yield sized, scab incidence, hollow heart or stem-end browning. Previous observation plots had indicated that 672 and 1344 kg/ha gypsum had produced the best yields and red clover was shown to increase scab incidence compared to timothy grass. No significant differences were observed in tuber periderm and leaf/petiole % Ca. Nor were there any significant differences between the treatments in relation to specific gravity, sucrose content or french fry color, though 1344 kg/ha gypsum showed the highest specific gravity with the best french fry color and lowest sucrose content.

ACKNOWLEDGEMENTS: The authors respectfully acknowledge A. Coté for help in setting out the project and D. McIsaac for carrying out tuber quality tests.

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GREEN MANURE - GYPSUM EFFECTS ON YIELD AND SCAB INCIDENCE IN THE POTATO CULTIVAR SHEPODY - II

R.P. Hinds and A.F. Perley

ABSTRACT: Green manure strips (fallow, buckwheat, leger barley and winter rye) were established in 1989 on the Holmesville clay loam soil series with a history of common scab, caused by **Streptomyces scabies**. The strips were chopped, plowed down green in the fall of 1989. Imposed on the strips in 1990 were 4 levels of gypsum (0, 672, 1344 and 2016 kg/ha) in a split plot design, to investigate the effects of green manure with gypsum on yield and scab incidence in the susceptible potato cultivar Shepody, in the absence of irrigation.

Gypsum rate, green manure and their interactions had no significant effect upon yield or scab incidence. In general, though, green manure treatments outyielded the fallow, with the leger barley performing the best both as a main treatment and in combination with 672 and 1344 kg/ha gypsum. Also in general, green manure treatments produced higher yields with less scab than the fallow with the leger barley as a main treatment and in combination with 672 and 1344 kg/ha gypsum showing the best promise in regard to scab reduction. Leger barley green manure treatments produced the lowest % of tubers with hollow heart and stem-end browning. Buckwheat was the worse in relation to hollow heart and stem-end browning.

EFFET DE L'ENGRAIS VERT ET DU GYPSE SUR LE RENDEMENT DE CULTIVARS DE POMME DE TERRE SHEPODY ET SUR LE TAUX DE GALE - II

Résumé: En 1989, une jachère et des cultures de sarrasin, d'orge Léger et de seigle d'hiver ont été constituées pour servir d'engrais vert sur des bandes de terrains composés de loam argileux de type Holmesville habituellement infestés par la gale commune causée par **Streptomyces scabies**. Ces cultures ont été hachées et enfouies dans le sol à l'automne de 1989. Les bandes ont reçu en 1990 quatre applications de gypse (0, 672, 1 344 et 2 016 kg par hectare) dans un dispositif expérimental afin d'analyser les effets de l'engrais vert et du gypse sur le rendement et sur le taux de gale dans le cultivar de pomme de terre Shepody sensible à la gale, le tout en l'absence d'irrigation.

Les applications de gypse et l'engrais vert, ainsi que leurs interactions, n'ont pas eu d'effet considérable sur le rendement ou sur le taux de gale. Toutefois, on a observé que l'engrais vert donnait en général un meilleur rendement que la jachère et que l'orge Léger donnait un meilleur rendement lorsqu'il constituait le principal traitement et qu'il était associé à des applications de 672 et 1 344 kg de gypse par hectare. On a également observé que l'engrais vert produisait en général de meilleurs rendements et des taux inférieurs de gale que la jachère, et que l'orge Léger comme traitement principal et en association avec des applications de 672 et 1 344 kg de gypse par hectare était le traitement le plus prometteur pour réduire la gale. L'engrais vert constitué d'une culture d'orge Léger a donné la plus faible proportion de tubercules atteints du coeur creux et du brunissement du talon. Le sarrasin a été le produit le moins efficace contre le coeur creux et le brunissement du talon.

INTRODUCTION: Common scab of potato, when severe, can severely reduce the quality of an otherwise good marketable crop. According to Bergey's Manual of Determinative Bacteriology, the taxonomic position of causal agent **Streptomyces scabies** is still uncertain, but for purposes of this discussion, the pathogen is being referred to as a gram positive filamentous bacterium (Anderson and Lorang, 1988).

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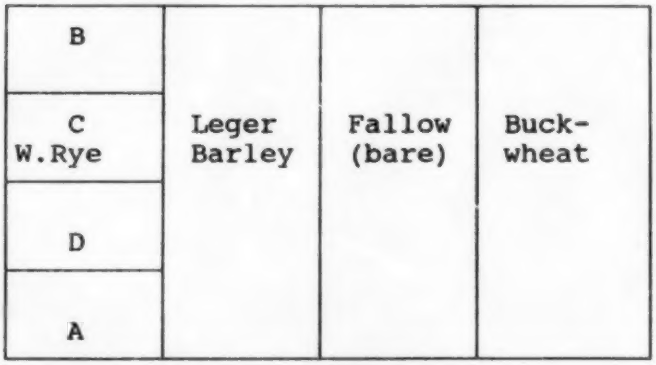
METHOD: Strips of green manure crops were established in 1989 on the Holmesville clay loam soil series, naturally infested with the common scab, **Streptomyces scabies**. The strips were planted as indicated below in a split plot design with 4 replications.



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REP I

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Shepody potato cultivar (scab-susceptible) was planted on May 20, 1990 and gypsum at the rate of 0, 672, 1344 and

2016 kg/ha were imposed on each strip. Gypsum used was 22% Ca and 16% S.

Main plots were 488 m² and sub-plots were 122 m². Data to be collected over the 3 year period include: O.M.%, soil analyses prior to and 8 weeks post-planting, leaf and petiole analyses at mid-season, yield (quantity and quality), hollow heart, tuber periderm % Ca, specific gravity, sucrose and french fry color. Scab incidence (tuber area % covered with lesions) was determined as per the key outlined in Ca. Plant Dis. Surv. 51: 197).

Basic fertilizer on Shepody was 135 kg/ha N, P and K. The first 3 weeks of July was dry during tuber initiation.

RESULTS AND DISCUSSION: Soil Analyses: Mean soil analyses results for the green manure and gypsum treatments are given in Tables 1 and 2. These plots show low to medium Ca levels, moderately acid and have produced scabby potatoes for the last twelve years. The addition of gypsum has increased Ca levels in the soil. This is usually not the case when soil Ca levels test high.

TABLE 1: Mean Soil Analyses at Four Levels of Gypsum on Shepody - 8 Weeks Post-Planting.

Gypsum Treatments	pH	% O.M.	kg/ha Ca
1. 0 kg/ha	6.1	2.9	1297
2. 672 kg/ha	6.0	2.9	1289
3. 1344 kg/ha	5.8	3.0	1382
4. 2016 kg/ha	5.9	2.8	1340

TABLE 2: Mean Soil Analyses Under Four Green Manure Treatments With Shepody - 8 Weeks Post-Planting.

Green Manure Treatment	pH	% O.M.	kg/ha Ca
1. Fallow	6.0	2.9	1396
2. Buckwheat	6.0	3.0	1423
3. Leger Barley	5.9	2.6	1235
4. Winter Rye	5.9	3.0	1254
5. Fallow (prev.yr.)	5.7	3.0	1259

Dry Matter Additions: Table 3 shows dry matter additions to the soil after 10 weeks of green manure growth in 1989. Leger barley added the greatest amount of dry matter, followed by buckwheat. The higher dry matter additions seemed to have little effect upon the O.M. content of the soil a year later. The fallow plots were harrowed twice to reduce weed population.

TABLE 3: Dry Matter Additions to the Soil From Green Manures - 10 Weeks Post-Planting, 1989.

Green Manure	t/ha Dry Matter Added	% O.M.
1. Fallow	2.4	2.9
2. Buckwheat	8.2	3.0
3. Leger Barley	10.6	2.6
4. Winter Rye	7.8	3.0

Yield: Mean yields for treatment effects (green manures, gypsum rates and their interactions) are given in Table 4. No significant differences were observed between green manures, gypsum rates or gypsum/green manure interactions. Observable trends in the data indicate, however, that the green manure treatments outyielded the fallow treatments with leger barley being the best. Interaction trends showed that leger barley with 672-1344 kg/ha gypsum and winter rye with 1344 kg/ha gypsum were among the best for yields. The fallow/gypsum interactions produced the lowest yields.

TABLE 4: Effect of Four Levels of Gypsum and Four Green Manure Treatments on Yield of Shepody Potato Cultivar.

Treatment	Yield-t/ha			
	<30mm	30-60 mm	>60mm	Total
Green Manures				
1. Fallow	0.28	24.03	13.92	38.23
2. Buckwheat	0.81	25.83	15.59	42.23
3. Leger Barley	0.25	26.04	18.13	44.42
4. Winter Rye	0.16	23.43	18.07	41.66
Gypsum Rates				
5. 0 kg/ha Gypsum	0.51	24.84	16.48	41.47
6. 672 kg/ha Gypsum	0.36	25.68	15.54	41.58
7. 1344 kg/ha Gypsum	0.51	24.31	17.27	41.73
8. 2016 kg/ha Gypsum	0.84	24.49	16.42	41.75
Green Manure x Gypsum Rate				
9. Fallow x 0 kg/ha Gypsum	0.25	23.57	15.13	38.95
10. Fallow x 672 kg/ha Gyp	0.36	24.79	12.60	37.75
11. Fallow x 1344 kg/ha Gyp	0.11	23.37	13.71	37.19
12. Fallow x 2016 kg/ha Gyp	0.43	24.39	14.23	39.05
13. Buckwheat x 0 kg/ha Gyp	0.16	26.11	14.93	41.20
14. Buckwheat x 672 kg/ha Gyp	0.41	25.91	15.54	41.86
15. Buckwheat x 1344 kg/ha Gyp	0.41	25.40	16.05	41.86
16. Buckwheat x 2016 kg/ha Gyp	2.23	25.91	15.85	43.99
17. L.Barley x 0 kg/ha Gyp	0.05	26.83	18.39	45.27
18. L.Barley x 672 kg/ha Gyp	0.51	28.86	15.54	44.91
19. L.Barley x 1344 kg/ha Gyp	0.05	23.47	21.24	44.76
20. L.Barley x 2016 kg/ha Gyp	0.36	25.00	17.37	42.73
21. Wint.Rye x 0 kg/ha Gyp	0.10	22.86	17.48	40.44
22. Wint.Rye x 672 kg/ha Gyp	0.16	23.17	18.49	41.82
23. Wint.Rye x 1344 kg/ha Gyp	0.05	25.00	18.08	43.13
24. Wint.Rye x 2016 kg/ha Gyp	0.33	22.68	18.24	41.25

(Treatment means not significant at 0.05 level)

Scab Incidence: The incidence of scab in Shepody with four green manures and gypsum, is shown in Table 5. Scab incidence in general, was low and no significant differences were observed between green manure treatments, gypsum rates or their interactions. Trends were in evidence, however. The green manure treatments produced a greater yield of tubers with less scab than the fallow treatment, with leger barley being the best. Also the leger barley treatment with 672-1344 kg/ha gypsum as well as the winter rye with 1344 kg/ha gypsum produced the highest yields with the least scab incidence.

TABLE 5: Effect of Four Levels of Gypsum and Four Green Manure Treatments on Scab Incidence in Shepody Potato Cultivar.

	Yield-t/ha		
	Tuber Area With Scab Lesions		
Treatment	0-10%	>10%	Total
Green Manures			
1. Fallow	37.28	0.95	38.23
2. Buckwheat	40.66	1.57	42.23
3. Leger Barley	43.60	0.82	44.42
4. Winter Rye	41.08	0.58	41.66
Gypsum Rates			
5. 0 kg/ha Gypsum	40.85	0.62	41.47
6. 672 kg/ha Gypsum	40.12	1.46	41.58
7. 1344 kg/ha Gypsum	40.83	0.90	41.73
8. 2016 kg/ha Gypsum	40.82	0.90	41.75
Green Manure x Gypsum Rate			
9. Fallow x 0 kg/ha Gypsum	38.27	0.68	38.95
10. Fallow x 672 kg/ha Gyp	36.57	1.18	37.75
11. Fallow x 1344 kg/ha Gyp	36.00	1.19	37.19
12. Fallow x 2016 kg/ha Gyp	38.25	0.80	39.05
13. Buckwheat x 0 kg/ha Gyp	40.18	1.02	41.20
14. Buckwheat x 672 kg/ha Gyp	38.73	3.13	41.86
15. Buckwheat x 1344 kg/ha Gyp	41.09	0.77	41.86
16. Buckwheat x 2016 kg/ha Gyp	42.65	1.34	43.99
17. L.Barley x 0 kg/ha Gyp	44.66	0.61	45.27
18. L.Barley x 672 kg/ha Gyp	44.58	0.33	44.91
19. L.Barley x 1344 kg/ha Gyp	43.41	1.35	44.76
20. L.Barley x 2016 kg/ha Gyp	41.75	0.98	42.73
21. Wint.Rye x 0 kg/ha Gyp	40.27	0.17	40.44
22. Wint.Rye x 672 kg/ha Gyp	40.62	1.20	41.82
23. Wint.Rye x 1344 kg/ha Gyp	42.83	0.30	43.13
24. Wint.Rye x 2016 kg/ha Gyp	40.61	0.64	41.25

(Treatment means not significant at 0.05 level)

Leaf/Petiole and Tuber Periderm % Ca: No significant differences were observed between leaf/petiole and tuber periderm % Ca of the gypsum treatments (Table 6). The data was similar for the green manure effects.

TABLE 6: Mean Leaf/Petiole and Tuber Periderm % Ca of Shepody as Affected by Four Levels of Gypsum.

Treatment	Leaf/Petiole % Ca	Tuber Periderm % Ca
1. 0 kg/ha Gypsum	0.87	0.09
2. 672 kg/ha Gypsum	0.84	0.09
3. 1344 kg/ha Gypsum	0.84	0.08
4. 2016 kg/ha Gypsum	0.85	0.08

French Fry Color, Sucrose Content and Specific Gravity: Table 7 shows the specific gravity, french fry color and sucrose content of Shepody as affected by four levels of gypsum. No significant differences were observed between treatments. Similar values for these qualities were observed under the green manure treatments.

TABLE 7: Specific Gravity, French Fry Color and Sucrose Content of Shepody as Affected by Four Levels of Gypsum.

Treatment	Specific Gravity	Fry Color* USDA Values	Sucrose mg/g
1. 0 kg/ha Gypsum	1.074	1.3	1.3
2. 672 kg/ha Gypsum	1.073	1.1	1.2
3. 1344 kg/ha Gypsum	1.074	1.1	1.3
4. 2016 kg/ha Gypsum	1.074	1.1	1.6

* USDA values of 1-4 are acceptable by processing trade.

Hollow Heart and Stem-End Browning: Observations on hollow heart and stem-end browning were made from the examination of 25 tubers in each plot and the relevant data are given in Table 8. Leger barley green manure produced the least amount of hollow heart and stem-end browning and buckwheat was the worst. Fallow/gypsum interactions and leger barley/gypsum interactions produced the least % of tubers with hollow heart. Buckwheat/gypsum interactions was the worst with regard to hollow heart. Leger barley/gypsum interactions produced the least % tubers with stem-end browning and buckwheat/gypsum interactions were the worst.

TABLE 8: Effect of Four Levels of Gypsum and Four Green Manure Treatments on Hollow Heart and Stem-End Browning of Shepody Potato Cultivar.

	% Tubers Affected	
Treatment	Hollow Heart	Stem-End Browning
Green Manures		
1. Fallow	0	5
2. Buckwheat	7	7
3. Leger Barley	1	0
4. Winter Rye	3	3
Gypsum Rates		
5. 0 kg/ha Gypsum	1	6
6. 672 kg/ha Gypsum	5	4
7. 1344 kg/ha Gypsum	3	2
8. 2016 kg/ha Gypsum	1	2
Green Manure x Gypsum Rates		
9. Fallow x 0 kg/ha Gypsum	0	2
10. Fallow x 672 kg/ha Gypsum	0	3
11. Fallow x 1344 kg/ha Gypsum	0	0
12. Fallow x 2016 kg/ha Gypsum	0	0
13. Buckwheat x 0 kg/ha Gypsum	1	1
14. Buckwheat x 672 kg/ha Gypsum	4	1
15. Buckwheat x 1344 kg/ha Gypsum	1	2
16. Buckwheat x 2016 kg/ha Gypsum	1	2
17. L.Barley x 0 kg/ha Gypsum	0	0
18. L.Barley x 672 kg/ha Gypsum	0	0
19. L.Barley x 1344 kg/ha Gypsum	1	0
20. L.Barley x 2016 kg/ha Gypsum	0	0
21. Winter Rye x 0 kg/ha Gypsum	1	3
22. Winter Rye x 672 kg/ha Gypsum	1	0
23. Winter Rye x 1344 kg/ha Gypsum	1	0
24. Winter Rye x 2016 kg/ha Gypsum	0	0

(Treatment means not significant at 0.05 level)

CONCLUSIONS: Gypsum treatments in the low to medium soil test soils increased Ca content but dry matter additions had no effect after the first year on O.M.% measured.

Gypsum, green manure treatments or their interactions had no significant effect upon yield or scab incidence. However, with regard to yields, indications are that the green manure treatments outyielded the fallow treatment with leger barley being the best. The leger barley treatment with 672-1344 kg/ha gypsum and the winter rye with 1344 kg/ha gypsum interaction were the better treatments for yield.

Similarly with scab incidence, green manure treatments produced a greater yield of tubers with less scab than the fallow, with leger barley being the best. Also the leger barley with 672-1344 kg/ha gypsum as well the winter rye with 1344 kg/ha gypsum produced the best yields with the least scab incidence.

No significant differences were noted between the treatments in relation to tuber periderm % Ca, leaf/petiole % Ca, sucrose content, french fry color or specific gravity.

Leger barley green manure produced the lowest % of tubers with hollow heart and stem-end browning. Buckwheat was the worst for hollow heart and stem-end browning. Fallow/gypsum and leger barley/gypsum interactions produced the least % of tubers with hollow heart whereas buckwheat/gypsum interactions were the worst. leger barley/gypsum interactions produced the least % of tubers with stem-end browning. Buckwheat/gypsum interactions were the worst for stem-end browning.

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